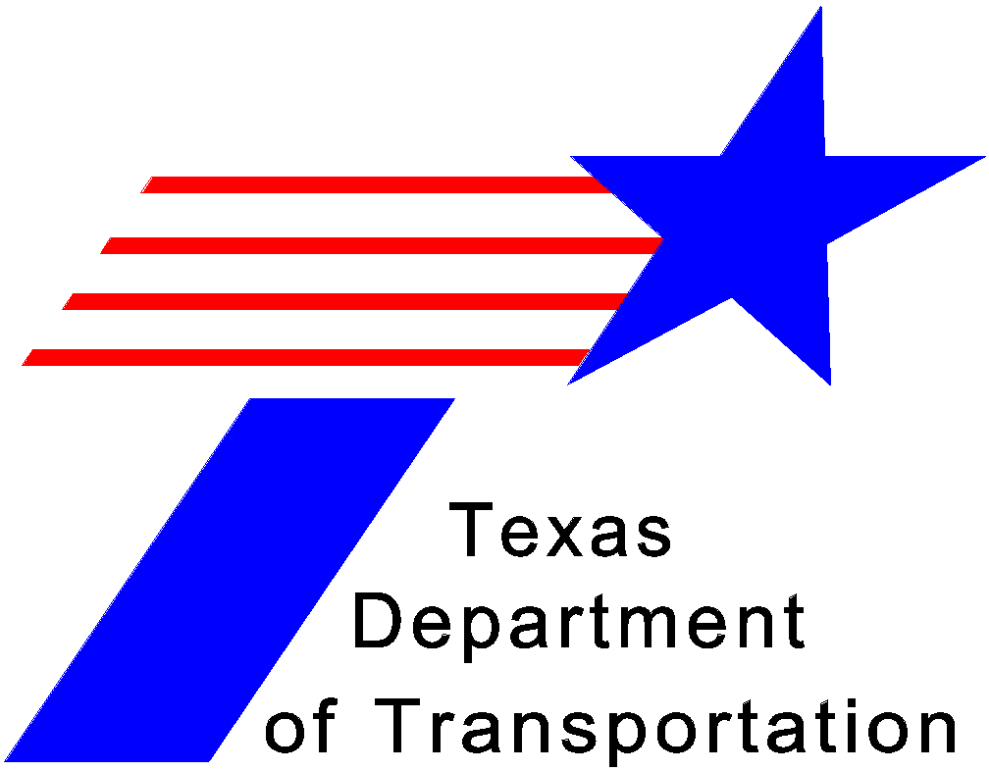
Bridge Detailing Manual



August 2001

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Chapter 1
General Information

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Section 1
Overview

Introduction

This manual provides general guidelines for use by bridge designers and technicians. It is intended neither to be all inclusive, nor to replace the judgment of the design engineers or detailers. All details are provided as examples only and are not intended to accurately reflect any particular structure. The conventions provided within this manual should assist in producing consistent plans.

The manual will be added to and updated on a periodic basis. Any errors or recommendations should be forwarded to the Director of Bridge Design.

The information in this manual is based on American Association of State Highway and Transportation Officials (**AASHTO**) Standard and Interim Specifications that have been modified to incorporate Bridge Division standard practices.

Section 2
Definitions

Structures

bridge - A bridge is a single span structure of over 20 feet, measured from face to face of abutments, or multiple span structures of over 20 feet (including multiple box culverts, measured between inside of end walls along the centerline of structure). Batteries of pipe culverts, regardless of their length, are not bridges.

culverts - Culverts are those drainage structures not defined as bridges

highway underpass - A highway underpass is a grade separation where the subject (funding) highway passes under an intersecting highway (also called a Highway Undercrossing)

highway overpass - A highway overpass is a grade separation where the subject (funding) highway passes over an intersecting highway (also called a Highway Overcrossing)

railroad underpass - A railroad underpass is a grade separation where a highway passes under an intersecting railroad (also called a Railroad Undercrossing)

railroad overpass - A railroad overpass is a grade separation where a highway passes over an intersecting railroad (also called a Railroad Overcrossing)

pedestrian underpass - A pedestrian underpass is a grade separation where a highway passes under an intersecting pedestrian walkway

stream crossing - A stream crossing is a location where the subject highway passes over an intersecting waterway

Standards

Statewide Standard Drawing - Drawings are not considered to be an available standard until a good quality reproducible print is made of the electronic file and this print is stamped "Original." This original print is kept on file in the Bridge Design Section of the Bridge Division. The electronic file of this original is available on TxDOT's Internet web site at http://www.dot.state.tx.us/insdtdot/orgchart/cmd/cserve/standard/disclaim.htm. Any reproducible copies made from the electronic file may be used in plan sets as if they were copies of the original reproducible print and need not be signed and sealed.

Modified Standard Drawing - Any change, however minor, to a standard drawing for use in a specific job, must be briefly described in the revision block of the sheet and dated. Additionally, the designation "(MOD)" must be placed after the standard name inside the title block.

District Standard Drawing - Any drawings used regularly within a district that were either developed by that district, or statewide standards that are revised to fit the individual needs of that district may be considered a district standard. Each district must identify their standards by including the district name in the title block. Only the issuing district may use this drawing as a standard without signing and sealing.

Section 3
County/District Information

District and Headquarters Map

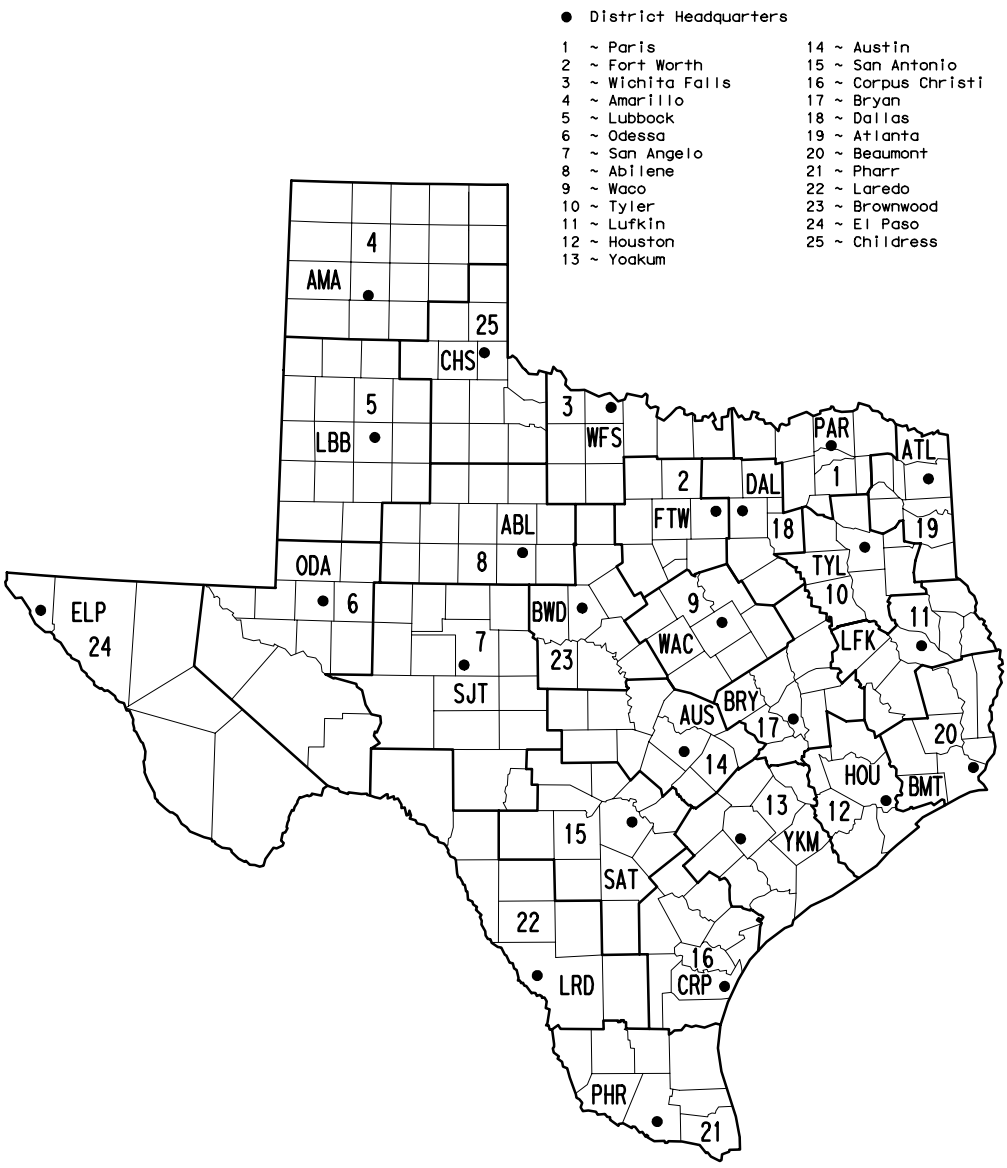


Figure 1-1: District and Headquarters Map. Online users can click 1-1 to view this illustration in PDF.

County Map

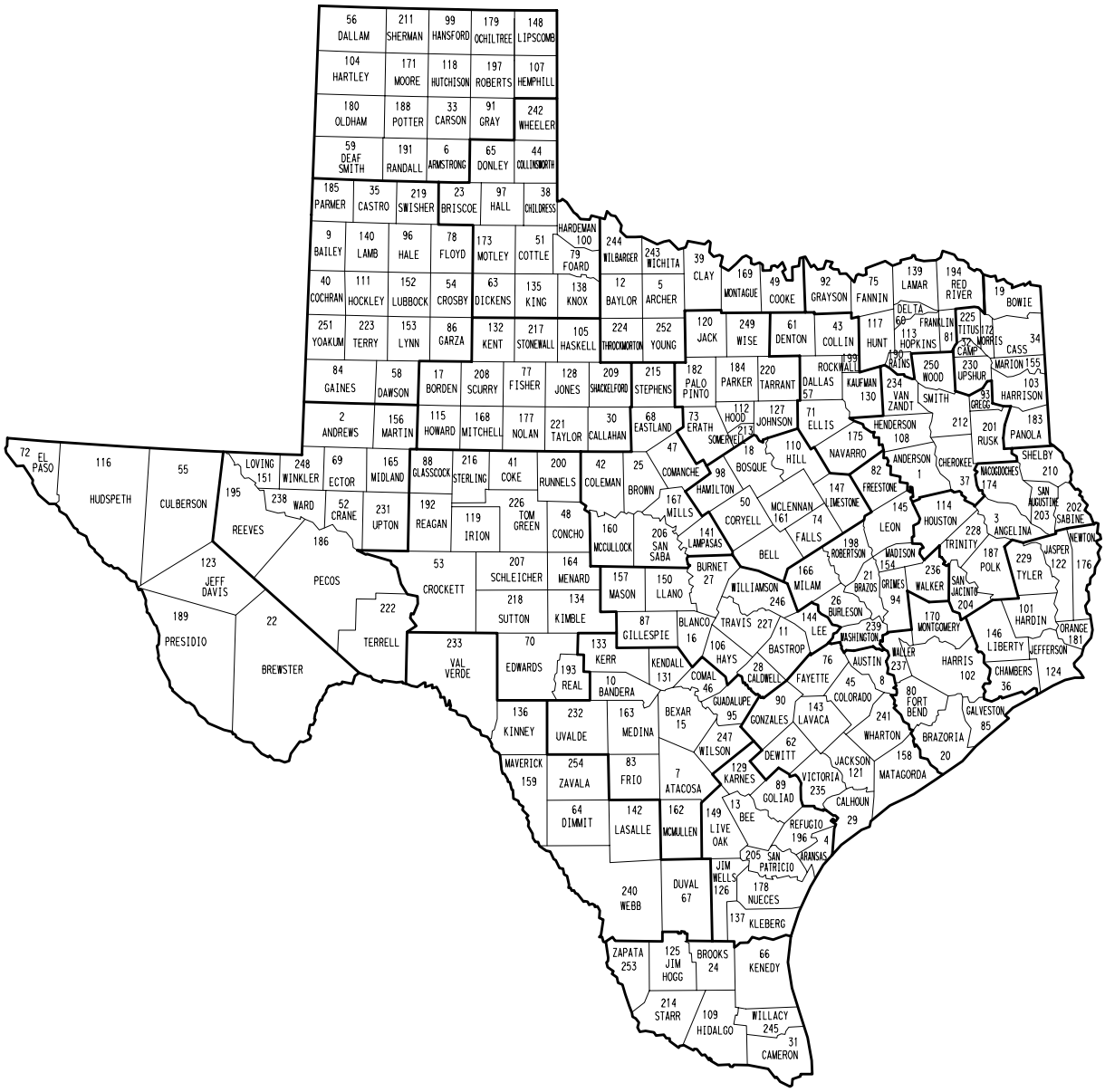


Figure 1-2: County Map. Online users can click 1-2 to view this illustration in PDF.

County/District Listing

001-10	Anderson	065-25	Donley	129-16	Karnes	192-07	Reagan
002-06	Andrews	066-21	Kenedy	130-18	Kaufman	193-07	Real
003-11	Angelina	067-22	Duval	131-15	Kendall	194-01	Red River
004-16	Aransas	068-23	Eastland	066-21	Kenedy	195-06	Reeves
005-03	Archer	069-06	Ector	132-08	Kent	196-16	Refugio
006-04	Armstrong	070-07	Edwards	133-15	Kerr	197-04	Roberts
007-15	Atascosa	071-18	Ellis	134-07	Kimble	198-17	Robertson
008-13	Austin	072-24	El Paso	135-25	King	199-18	Rockwall
009-05	Bailey	073-02	Erath	136-22	Kinney	200-07	Runnels
010-15	Bandera	074-09	Falls	137-16	Kleberg	201-10	Rusk
011-14	Bastrop	075-01	Fannin	138-25	Knox	202-11	Sabine
012-03	Baylor	076-13	Fayette	139-01	Lamar	203-11	San Augustine
013-16	Bee	077-08	Fisher	140-05	Lamb	204-11	San Jacinto
014-09	Bell	078-05	Floyd	141-23	Lampasas	205-16	San Patricio
015-15	Bexar	079-25	Foard	142-22	LaSalle	206-23	San Saba
016-14	Blanco	080-12	Fort Bend	143-13	Lavaca	207-07	Schleicher
017-08	Borden	081-01	Franklin	144-14	Lee	208-08	Scurry
018-09	Bosque	082-17	Freestone	145-17	Leon	209-08	Shackelford
019-19	Bowie	083-15	Frio	146-20	Liberty	210-11	Shelby
020-12	Brazoria	084-05	Gaines	147-09	Limestone	211-04	Sherman
021-17	Brazos	085-12	Galveston	148-04	Lipscomb	212-10	Smith
022-24	Brewster	086-05	Garza	149-16	Live Oak	213-02	Somervell
023-25	Briscoe	087-14	Gillespie	150-14	Llano	214-21	Starr
024-21	Brooks	088-07	Glasscock	151-06	Loving	215-23	Stephens
025-23	Brown	089-16	Goliad	152-05	Lubbock	216-07	Sterling
026-17	Burleson	090-13	Gonzales	153-05	Lynn	217-08	Stonewall
027-14	Burnet	091-04	Gray	154-17	Madison	218-07	Sutton
028-14	Caldwell	092-01	Grayson	155-19	Marion	219-05	Swisher
029-13	Calhoun	093-10	Gregg	156-06	Martin	220-02	Tarrant
030-08	Callahan	094-17	Grimes	157-14	Mason	221-08	Taylor
031-21	Cameron	095-15	Guadalupe	158-13	Matagorda	222-06	Terrell
032-19	Camp	096-05	Hale	159-22	Maverick	223-05	Terry
033-04	Carson	097-25	Hall	160-23	McCulloch	224-03	Throckmorton
034-19	Cass	098-09	Hamilton	161-09	McLennan	225-19	Titus
035-05	Castro	099-04	Hansford	162-15	McMullen	226-07	Tom Green
036-20	Chambers	100-25	Hardeman	163-15	Medina	227-14	Travis
037-10	Cherokee	101-20	Hardin	164-07	Menard	228-11	Trinity
A38-25	Childress	102-12	Harris	165-06	Midland	229-20	Tyler
039-03	Clay	103-19	Harrison	166-17	Milam	230-19	Upshur
040-05	Cochran	104-04	Hartley	167-23	Mills	231-06	Upton
041-07	Coke	105-08	Haskell	168-08	Mitchell	232-15	Uvalde
042-23	Coleman	106-14	Hays	169-03	Montague	233-22	Val Verde
043-18	Collin	107-04	Hemphill	170-12	Montgomery	234-10	Van Zandt
044-25	Collingsworth	108-10	Henderson	171-04	Moore	235-13	Victoria
045-13	Colorado	109-21	Hidalgo	172-19	Morris	236-17	Walker
046-15	Comal	110-09	Hill	173-25	Motley	237-12	Waller
047-23	Comanche	111-05	Hockley	174-11	Nacogdoches	238-06	Ward
048-07	Concho	112-02	Hood	175-18	Navarro	239-17	Washington
049-03	Cooke	113-01	Hopkins	176-20	Newton	240-22	Webb
050-09	Coryell	114-11	Houston	177-08	Nolan	241-13	Wharton
051-25	Cottle	115-08	Howard	178-16	Nueces	242-25	Wheeler
052-06	Crane	116-24	Hudspeth	179-04	Ochiltree	243-03	Wichita
053-07	Crockett	117-01	Hunt	180-04	Oldham	244-03	Wilbarger
054-05	Crosby	118-04	Hutchinson	181-20	Orange	245-21	Willacy
055-24	Culberson	119-07	Irion	182-02	Palo Pinto	246-14	Williamson
056-04	Dallam	120-02	Jack	183-19	Panola	247-15	Wilson
057-18	Dallas	121-13	Jackson	184-02	Parker	248-06	Winkler
058-05	Dawson	122-20	Jasper	185-05	Parmer	249-02	Wise
059-04	Deaf Smith	123-24	Jeff Davis	186-06	Pecos	250-10	Wood
060-01	Delta	124-20	Jefferson	187-11	Polk	251-05	Yoakum
061-18	Denton	125-21	Jim Hogg	188-04	Potter	252-03	Young
062-13	Dewitt	126-16	Jim Wells	189-24	Presidio	253-21	Zapata
063-25	Dickens	127-02	Johnson	190-01	Rains	254-22	Zavala
064-22	Dimmit	128-08	Jones	191-04	Randall		

Figure 1-3: County/District Listing. Online users can click 1-3 to view this illustration in PDF.

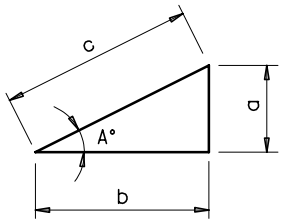
Section 4
Useful Information

General Formulas

Trigonometric Formulas

$$c^2 = a^2 + b^2$$

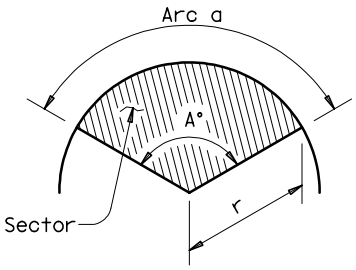
$$\text{Sin } A^\circ = a \div c$$
$$\text{Cos } A^\circ = b \div c$$
$$\text{Tan } A^\circ = a \div b$$



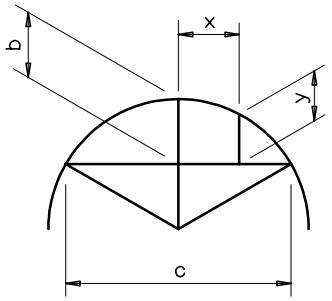
Properties of The Circle

1 Radian = 57.29578°
1 Degree = 0.01745329 Radians

$$\text{Arc } a = (\pi\, r\, A^\circ) \div 180^\circ$$
$$= 0.017453\, r\, A^\circ$$
$$\text{Angle } A^\circ = (180^\circ\, a) \div (\pi\, r)$$
$$= (57.29578\, a) \div r$$
$$\text{Sector Area} = (a\, r) \div 2$$
$$= 0.0087266\, A^\circ\, r^2$$
$$\text{Radius } r = (4\, b^2 + c^2) \div 8\, b$$



$$\text{Chord } c = 2\sqrt{(2\, b\, r) - b^2}$$
$$= 2\, r\, \text{Sin } (A^\circ \div 2)$$
$$\text{Rise } b = r - .5\sqrt{4\, r^2 - c^2}$$
$$= .5\, c\, \text{Tan } (A^\circ \div 4)$$
$$= 2\, r\, \text{Sin}^2 (A^\circ \div 4)$$
$$= r + y - \sqrt{r^2 - x^2}$$
$$y = b - r + \sqrt{r^2 - x^2}$$
$$x = \sqrt{r^2 - (r + y - b)^2}$$



$$\text{Segment Area} = \frac{\pi\, r^2\, A^\circ}{360} - \frac{r^2\, \text{Sin } A^\circ}{2}$$

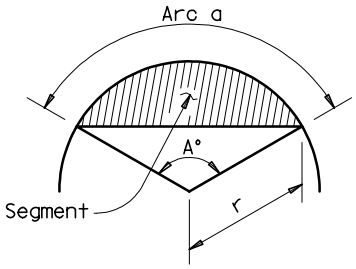


Figure 1-4: General Formulas. Online users can click 1-4 to view this illustration in PDF.

Tables of English Decimal Values

Table 1-1: Decimals of a foot for each 1/16 of an inch

Inch	0"	1"	2"	3"	4"	5"	6"	7"	8"	9"	10"	11"
0″	.0000	.0833	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167
1/16″	.0052	.0885	.1719	.2552	.3385	.4219	.5052	.5885	.6719	.7552	.8385	.9219
1/8″	.0104	.0938	.1771	.2604	.3438	.4271	.5104	.5938	.6771	.7604	.8438	.9271
3/16″	.0156	.0990	.1823	.2656	.3490	.4323	.5156	.5990	.6823	.7656	.8490	.9323
1/4″	.0208	.1042	.1875	.2708	.3542	.4375	.5208	.6042	.6875	.7708	.8542	.9375
5/16″	.0260	.1094	.1927	.2760	.3594	.4427	.5260	.6094	.6927	.7760	.8594	.9427
3/8″	.0313	.1146	.1979	.2813	.3646	.4479	.5313	.6146	.6979	.7813	.8646	.9479
7/16″	.0365	.1198	.2031	.2865	.3698	.4531	.5365	.6198	.7031	.7865	.8698	.9531
1/2″	.0417	.1250	.2083	.2917	.3750	.4583	.5417	.6250	.7083	.7917	.8750	.9583
9/16″	.0469	.1302	.2135	.2969	.3802	.4635	.5469	.6302	.7135	.7969	.8802	.9635
5/8″	.0521	.1354	.2188	.3021	.3854	.4688	.5521	.6354	.7188	.8021	.8854	.9688
11/16″	.0573	.1406	.2240	.3073	.3906	.4740	.5573	.6406	.7240	.8073	.8904	.9740
3/4″	.0625	.1458	.2292	.3125	.3958	.4792	.5625	.6458	.7292	.8125	.8958	.9792
13/16″	.0677	.1510	.2344	.3177	.4010	.4844	.5677	.6510	.7344	.8177	.9010	.9844
7/8″	.0729	.1563	.2396	.3229	.4063	.4896	.5729	.6563	.7396	.8229	.9063	.9896
15/16″	.0781	.1615	.2448	.3281	.4115	.4948	.5781	.6615	.7448	.8281	.9115	.9948

Table 1-2: Decimals of an inch for each 1/16 of an inch

Fraction	Decimal	Fraction	Decimal	Fraction	Decimal	Fraction	Decimal
1/16″	.0625"	*5/16″*	.3125"	*9/16″*	.5625"	*13/16″*	.8125"
1/8″	.1250"	*3/8″*	.3750"	*5/8″*	.6250"	*7/8″*	.8750"
3/16″	.1875"	*7/16″*	.4375"	*11/16″*	.6875"	*15/16″*	.9375"
1/4″	.2500"	*1/2″*	.5000"	*3/4″*	.7500"	*1″*	1.0000"

Table 1-3: Detailing Tolerances

Detail		Shown to Nearest
All framing and forming dimensions for steel and concrete components		0.001 ft. or 1/16 in.
Locations of columns, shafts, and piling (Use 3" increments unless spacing depends on preset conditions)		0.001 ft.
Reinforcing steel dimensions (Use nearest 1/2" or 1" where practical. Show to nearest 1" in Bar Table.)		1/4 in.
Reinforcing steel spacing		1/4 in.
Stations		0.01 ft.
Elevations	Layouts	0.01 ft.
Elevations	Everywhere else	0.001 ft.
Angles		1 sec.
Column H heights		1 ft.
Drilled shaft and pile lengths		1 ft.

Table 1-4: Material Weights

Material	Lbs / CF
Concrete, reinforced, stone	150
Concrete, plain, stone	144
Concrete, plain, slag	130
Concrete, light weight	50-80
Asphalt surfacing	140
Aluminum, cast, hammered	165
Brass, cast, rolled	534
Bronze	544
Copper, cast, rolled	556
Iron, cast, gray, or pig	450
Iron, wrought	480
Lead	706
Magnesium alloy	112
Stainless steel	492-510
Steel, rolled	490
Water, 4º C (max density)	62.428
Water, 100º C	59.830
Clean ice	56
Snow, fresh	8
Oil	54
Gasoline	75
Granite	175
Limestone	165
Marble	165
Sandstone	147
Slate	175
Clay, dry	63
Clay, damp, plastic	110
Clay and gravel, dry	100
Earth, dry, loose	76
Earth, dry, packed	95
Earth, mud, flowing	108
Earth, mud, packed	115
Sand or gravel excavation in water	60
Clay excavation in water	80
River mud excavation	90
Soil excavation in water	70
Timber or lumber	50
Plywood	50

Section 5
Detailing Information

Graphic Guidelines

Drafters and engineers should keep in mind that the ultimate products of their work are the 11" x 17" prints made from their drawings. The standards and guidelines given in this manual are intended to improve print quality and readability.

Besides using recommended line weights, scales, and the Bridge Division's customized font, individual printers must be adjusted to closely match the line weights on hardcopies made from Bridge Division printers. Issued standards on 11" x 17" paper may be used as an aid in establishing acceptable line weights or, upon request, 11" x 17" paper examples will be provided.

Standard Scales

Standard drafting scales (either engineering or architectural) shall be used when creating a detail sheet so the details on the final, contract, or construction plans are measurable. This requirement does not imply that prints of detail sheets should be measured in the field to establish construction dimensions. The drawing accuracy is intended only to assist in eliminating constructibility and dimensioning errors. The dimensions presented in the details shall control all construction.

Table 1-5: English Scales

Dimension	Scale
Full	1:1
1 1/2" = 1' – 0"	1:8
1" = 1' – 0"	1:12
3/4" = 1' – 0"	1:16
1/2" = 1' – 0"	1:24
3/8" = 1' – 0"	1:32
1/4" = 1' – 0"	1:48
1/8" = 1' – 0"	1:96
1" = 10' – 0"	1:120
1" = 20' – 0"	1:240
1" = 40' – 0"	1:480
1" = 50' – 0"	1:600
1" = 100' – 0"	1:1200

Text Information

Unless otherwise noted, Leroy style characters shall be used for all text. (Font #1 from the TxDOT font resource file shall be used whenever possible.) The following listed parameters should be generally followed when placing text.

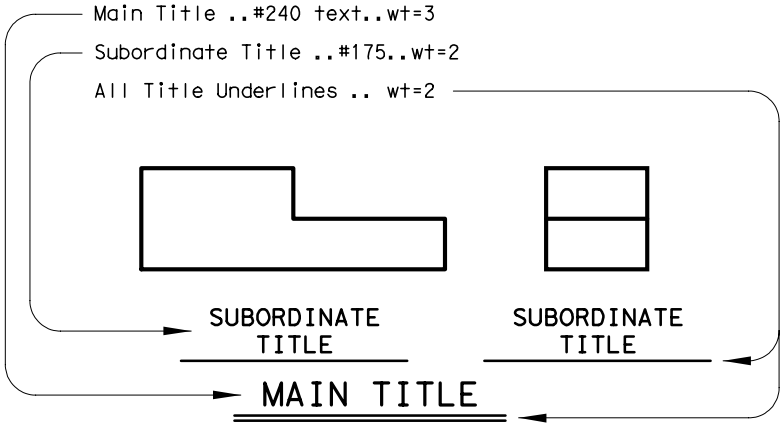


Figure 1-5: Main Details. Online users can click 1-5 to view this illustration in PDF.

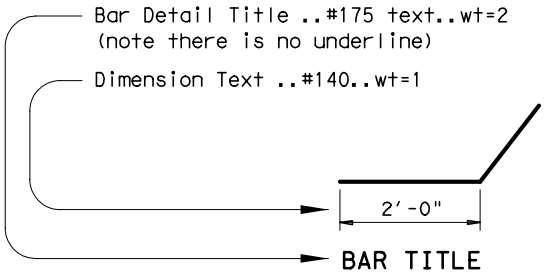


Figure 1-6: Bar Details. Online users can click 1-6 to view this illustration in PDF.

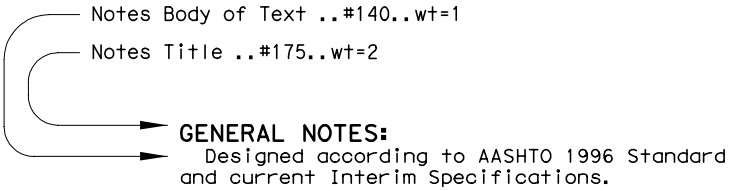


Figure 1-7: Notes and General Text. Online users can click 1-7 to view this illustration in PDF.

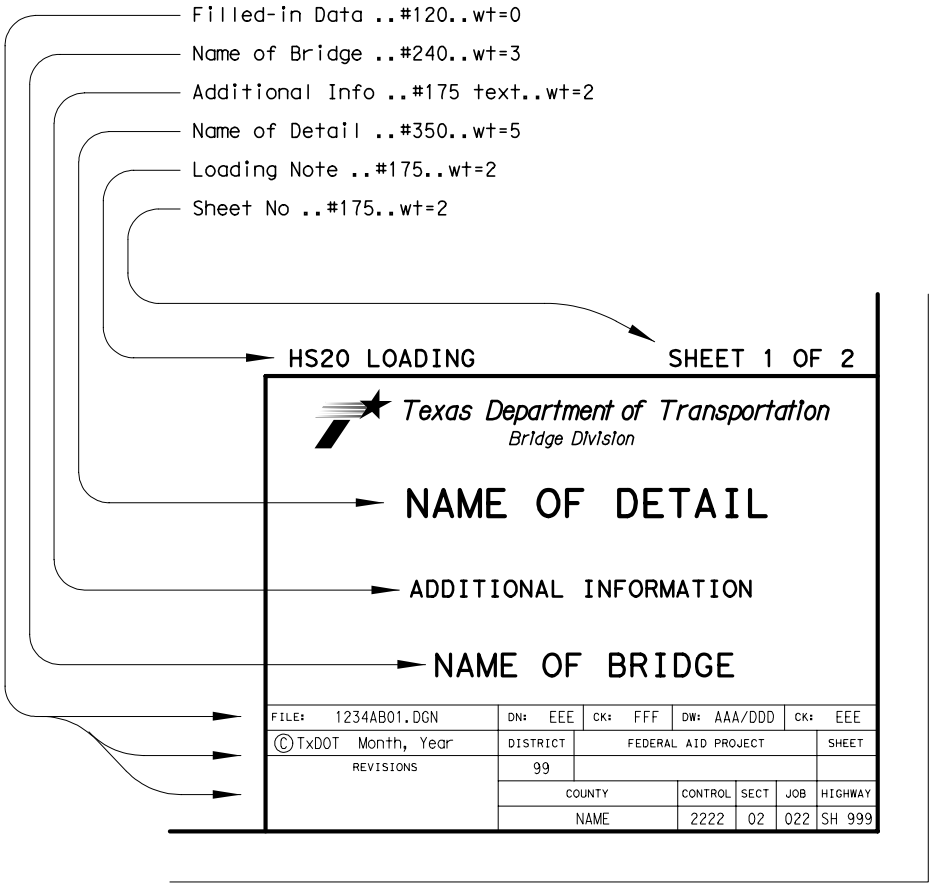


Figure 1-8: Detail Sheet Title Blocks. Online users can click 1-8 to view this illustration in PDF.

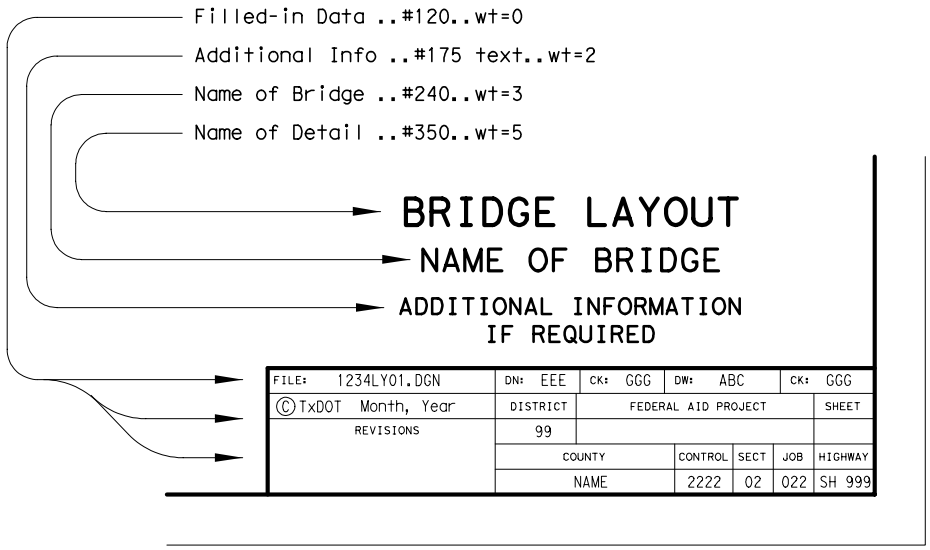
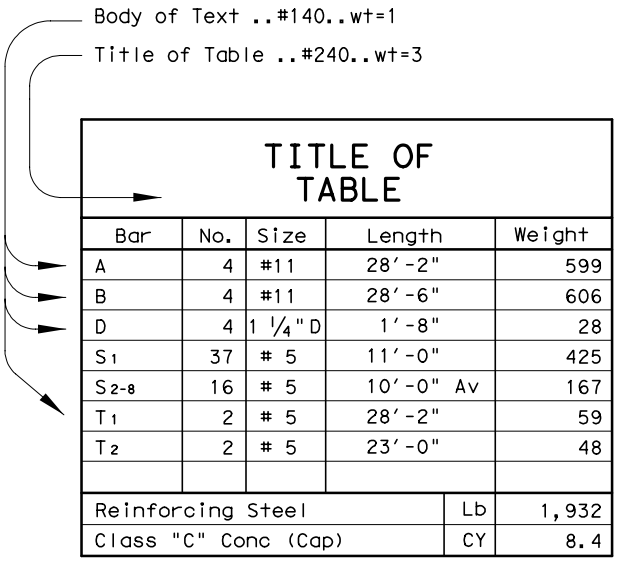


Figure 1-9: Layout Sheet Title Blocks. Online users can click 1-9 to view this illustration in PDF.



TITLE OF TABLE

Bar	No.	Size	Length	Weight
A	4	#11	28′-2"	599
B	4	#11	28′-6"	606
D	4	1 ¼"D	1′-8"	28
S_1	37	# 5	11′-0"	425
S_{2-8}	16	# 5	10′-0" Av	167
T_1	2	# 5	28′-2"	59
T_2	2	# 5	23′-0"	48
Reinforcing Steel			Lb	1,932
Class "C" Conc (Cap)			CY	8.4

Figure 1-10: Tables. Online users can click 1-10 to view this illustration in PDF.

Abbreviations

To save space, do not use a period after commonly abbreviated words such as max, min, typ, spa, etc. Use a period only after abbreviations that spell a word, such as no., and abbreviations that are not commonly recognized.

Symbol Reference

When using more than one or two symbols, use circles with numbers (① ⑩) to reference notes, dimensions, details, etc., instead of using symbols.

Line Weights

The following listed line weights shall be used in the Bridge Division for structural detailing. Small or delicate details may require using smaller line weights for clarity.

Table 1-6: Line Weights

Line Type	Weight	Style
Object lines	#3	Solid
♦ Interior detail lines	#2	Solid
♦ Delicate detail lines	#2	Solid
Rebar details	#3	Solid
♦ Or, for smaller details	#2	Solid
Rebar	#1	Solid
Hidden object lines	#1	Short-dashed
Crosshatching	#0	Solid, dashed, etc.
Existing structure lines	#2	Dashed
Centerlines	#0	Dot dash
Baselines and alignment lines	#0	Dot dash
♦ Or, if required for clarity	#1	Short-dash long-dash
Dimension lines, leader lines, etc.	#0	Solid
Arrowheads	#1	Solid
Tabular outlines	#2	Solid
Tabular row lines	#0	Solid
Tabular column lines	#2	Solid
Sheet outlines	#4	Solid
Sheet cutlines	#0	Solid
Text (notes and labels)	#1	Solid
(See Text Information for weights of text in titles)		

Dimensions

Generally, construction dimensions are shown in feet and inches. Decimals of a foot should be used where dimensions are being set by surveying equipment, such as beam spacing, foundation locations, and structure widths in plan views on detail sheets.

Commas

Use commas to separate blocks of three digits or any number with four or more digits.

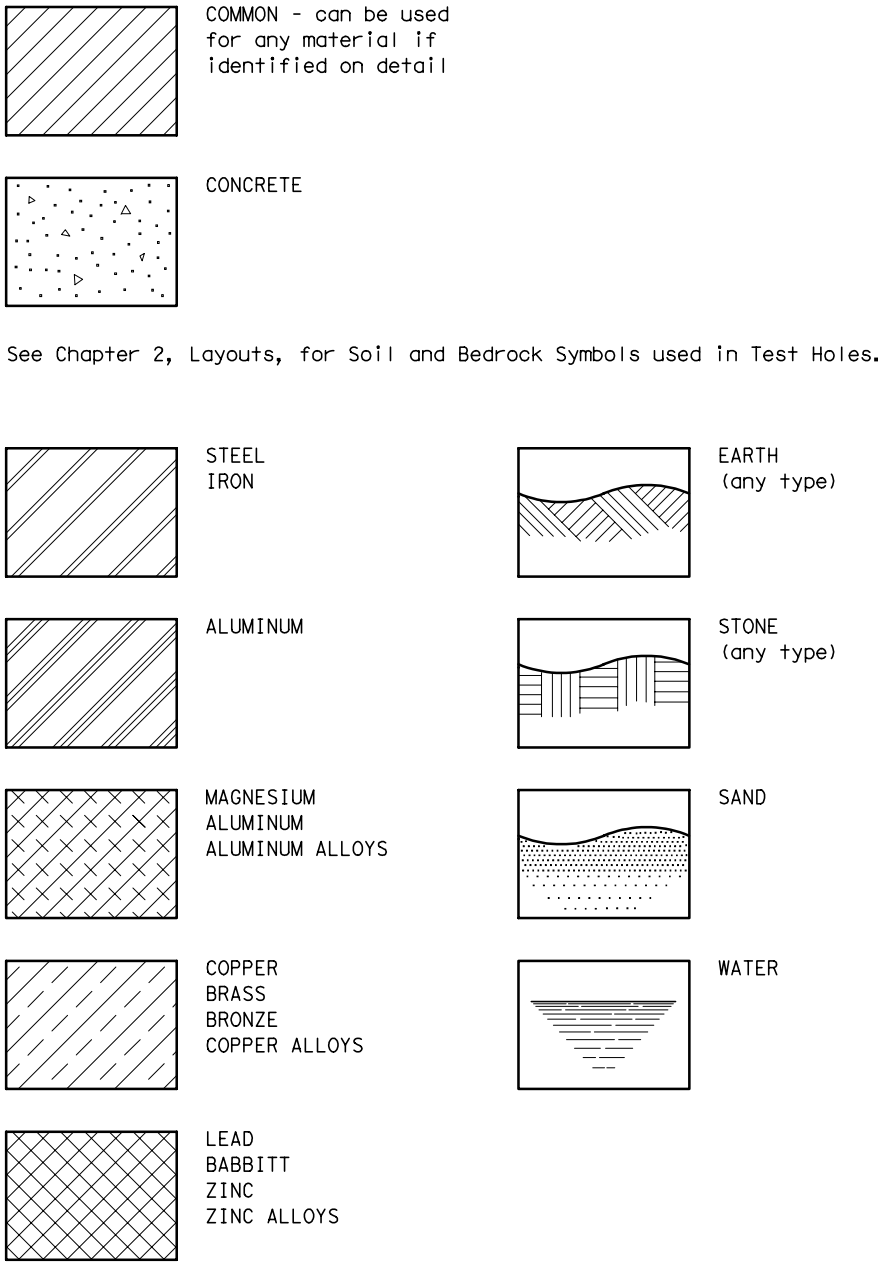


Figure 1-11: Section Symbology. Online users can click 1-11 to view this illustration in PDF

Section 6
Reinforcing Steel

Table of Standard Reinforcing Steel Bars

On quantity tables, show the length to the nearest inch and the weight to the nearest pound.

Table 1-7: Standard Reinforcing Steel Specifications

English Designations	Nom Bar Dia (Inches)		Weight (Lbs per LF)	Area (Sq Inches)
#3	0.375	3/8	0.376	0.110
#4	0.500	1/2	0.668	0.196
#5	0.625	5/8	1.043	0.307
#6	0.750	3/4	1.502	0.442
#7	0.875	7/8	2.044	0.601
#8	1.000	1	2.670	0.785
#9	1.128	1 1/8	3.400	1.000
#10	1.270	1 1/4	4.303	1.266
#11	1.410	1 3/8	5.313	1.563
#14	1.693	1 3/4	7.650	2.250
#18	2.257	2 1/4	13.600	4.000
1 1/4" Dia Smooth	1.250	1 1/4	4.172	1.227

Bar Labels

For bar labels, use upper case letters according to the designations listed in Table 1-8 where possible. Letters not designated may be used as necessary.

Lowercase prefix letters may be used to identify bars in sub-components such as wings. Examples are wH, wV, wU, and wS or wP bars in wingwalls. Prefix letters should be used only where there is a definite improvement in clarity from flagging the steel in sub-components separately from other reinforcing steel.

See individual chapters for detail examples of the normal bar designations.

Table 1-8: Preferred Bar Labels

Label	Description
A	Main bars top and bottom or Main bars top
B	Main bars bottom (Slabs on stringers or caps)
C	-
D	Distribution bars or dowels
E	Cap pedestal bars
F	Footings
G	-
H	Horizontal bars
I	(do not use)
J	Shape
K	-
L	Shape
M	-
N	-
O	(do not use)
P	-
Q	(not preferred)
R	-
S	Stirrups
T	Temperature steel
U	Shape
V	Vertical bars
W	-
X	Slab dowels
Y	-
Z	Spiral bars

English Development Length and Splices

Class B splice – 50 percent or less of the bars spliced at one location*
(except conventional slab reinforcing)
* Epoxy coated splice lengths by designing engineer (round up to even inch)

Table 1-9: Class B Splices

Size	A Ld	B 1.3 Ld	C 1.3 (1.4) Ld	D 1.3 (1.4) 0.8 Ld	E 1.3 (0.8) Ld
Grade 40	fy=40,000 psi f 'c=3,600 psi (Class C Concrete)				
#3	(6.00") 1' – 0"	1' – 0"	1' – 0"	1' – 0"	1' – 0"
#4	(8.00") 1' – 0"	1' – 0"	1' – 3"	1' – 0"	1' – 0"
#5	(10.00") 1' – 0"	1' – 1"	1' – 7"	1' – 3"	1' – 0"
#6	(12.00") 1' – 0"	1' – 4"	1' – 10"	1' – 6"	1' – 1"
#7	(16.03") 1' – 5"	1' – 9"	2' – 6"	2' – 0"	1' – 5"
#8	(20.93") 1' – 9"	2' – 4"	3' – 3"	2' – 7"	1' – 10"
#9	(26.67") 2' – 3"	2' –11"	4' – 1"	3' – 3"	2' – 4"
#10	(33.76") 2' – 10"	3' – 8"	5' – 2"	4' – 2"	3' – 0"
#11	(41.68") 3' – 6"	4' – 7"	6' – 4"	5' – 1"	3' – 8"
#14	(56.67") 4' – 9"	-	-	-	-
#18	(73.33") 6' – 2"	-	-	-	-
Grade 60	fy=60,000 psi f 'c=3,600 psi (Class C Concrete)				
#3	(9.00") 1' – 0"	1' – 0"	1' – 5"	1' – 2"	1' – 0"
#4	(12.00") 1' – 0"	1' – 4"	1' – 10"	1' – 6"	1' – 1"
#5	(15.00") 1' – 3"	1' – 8"	2' – 4"	1' – 10"	1' – 4"
#6	(18.00") 1' – 6"	2' – 0"	2' – 9"	2' – 3"	1' – 7"
#7	(24.04") 2' – 1"	2' – 8"	3' – 8"	2' –11"	2' – 1"
#8	(31.40") 2' – 8"	3' – 5"	4' – 10"	3' – 10"	2' – 9"
#9	(40.00") 3' – 4"	4' – 4"	6' – 1"	4' – 11"	3' – 6"
#10	(50.64") 4' – 3"	5' – 6"	7' – 9"	6' – 2"	4' – 5"
#11	(62.52") 5' – 3"	6' – 10"	9' – 6"	7' – 8"	5' – 6"
#14	(85.00") 7' – 1"	-	-	-	-
#18	(110.00") 9' – 2"	-	-	-	-

Class B splice – 50 percent or less of the bars spliced at one location*
(except conventional slab reinforcing)
* Epoxy coated splice lengths by designing engineer (round up to even inch)

Table 1-10: Class B Information

Description	Code
Ld ~ basic development length	A
Bent cap and deep slab main reinforcing splices (deeper than 12")	-
♦ 1.3 (1.4) Ld ~ top bars spaced less than 6" C-C	C
♦ 1.3 (1.4) (0.8) Ld ~ top bars spaced 6" C-C or more	D
♦ 1.3 Ld ~ bottom bars spaced less than 6" C-C	B
♦ 1.3 (0.8) Ld ~ bottom bars spaced 6" C-C or more	E
Column vertical reinforcing splices	-
♦ 1.3 Ld ~ bars spaced less than 6" C-C	B
♦ 1.3 (0.8) Ld ~ bars spaced 6" C-C or more	E
Temperature reinforcing splices	-
♦ Ld ~ regardless of spacing	A
Column to drill shaft or footing reinforcing lapped splices (See Class C Splices)	
Conventional slab reinforcing splices (See concrete slab reinforcing splices)	

Class C splice – more than 50 percent of the bars spliced at one location*
(except conventional slab reinforcing)
* Epoxy coated splice lengths by designing engineer (round up to even inch)

Table 1-11: Class C Splices

Size	A Ld		B 1.7 Ld	C 1.7 (1.4) Ld	D 1.7 (1.4) 0.8 Ld	E 1.7 (0.8) Ld
Grade 40	fy=40,000 psi	f 'c=3,600 psi (Class C Concrete)				
#3	(6.00")	1' – 0"	1' – 0"	1' – 3"	1' – 0"	1' – 0"
#4	(8.00")	1' – 0"	1' – 2"	1' – 8"	1' – 4"	1' – 0"
#5	(10.00")	1' – 0"	1' – 5"	2' – 0"	1' – 8"	1' – 2"
#6	(12.00")	1' – 0"	1' – 9"	2' – 5"	1' – 11"	1' – 5"
#7	(16.03")	1' – 5"	2' – 4"	3' – 3"	2' – 7"	1' – 10"
#8	(20.93")	1' – 9"	3' – 0"	4' – 2"	3' – 4"	2' – 5"
#9	(26.67")	2' – 3"	3' –10"	5' – 4"	4' – 3"	3' – 1"
#10	(33.76")	2' – 10"	4' – 10"	6' – 9"	5' – 5"	3' – 10"
#11	(41.68")	3' – 6"	5' – 11"	8' – 4"	6' – 8"	4' – 9"
#14	(56.67")	4' – 9"	-	-	-	-
#18	(73.33")	6' – 2"	-	-	-	-
Grade 60	fy=60,000 psi	f 'c=3,600 psi (Class C Concrete)				
#3	(9.00")	1' – 0"	1' – 4"	1' – 10"	1' – 6"	1' – 1"
#4	(12.00")	1' – 0"	1' – 9"	2' – 5"	1' – 11"	1' – 5"
#5	(15.00")	1' – 3"	2' – 2"	3' – 0"	2' – 5"	1' – 9"
#6	(18.00")	1' – 6"	2' – 7"	3' – 7"	2' – 11"	2' – 1"
#7	(24.04")	2' – 1"	3' – 5"	4' – 10"	3' –10"	2' – 9"
#8	(31.40")	2' – 8"	4' – 6"	6' – 3"	5' – 0"	3' – 7"
#9	(40.00")	3' – 4"	5' – 8"	8' – 0"	6' – 5"	4' – 7"
#10	(50.64")	4' – 3"	7' – 3"	10' – 1"	8' – 1"	5' – 9"
#11	(62.52")	5' – 3"	8' – 11"	12' – 5"	10' – 0"	7' – 2"
#14	(85.00")	7' – 1"	-	-	-	-
#18	(110.00")	9' – 2"	-	-	-	-

Class C splice – more than 50 percent of the bars spliced at one location*
(except conventional slab reinforcing)
* Epoxy coated splice lengths by designing engineer (round up to even inch)

Table 1-12: Class C Information

Description	Code
Ld ~ basic development length	A
Bent cap and deep slab main reinforcing splices (deeper than 12")	-
♦ 1.7 (1.4) Ld ~ top bars spaced less than 6" C-C	C
♦ 1.7 (1.4) (0.8) Ld ~ top bars spaced 6" C-C or more	D
♦ 1.7 Ld ~ bottom bars spaced less than 6" C-C	B
♦ 1.7 (0.8) Ld ~ bottom bars spaced 6" C-C or more	E
Column vertical reinforcing splices	-
♦ 1.7 Ld ~ bars spaced less than 6" C-C	B
♦ 1.7 (0.8) Ld ~ bars spaced 6" C-C or more	E
Temperature reinforcing splices	-
♦ Ld ~ regardless of spacing	A
Column to drill shaft or footing reinforcing lapped splices	-
♦ 1.7 Ld ~ all bars regardless of spacing	B
Conventional slab reinforcing splices (See concrete slab reinforcing splices)	

Concrete Slab Reinforcing Lapped Splices

Class C Splice – more than 50 percent of the bars spliced at one location

Table 1-13: Slab Reinforcing Splices

Size	A 1.7 (0.8) Ld	B 1.7 (0.8) 1.5 Ld	C 1.7 Ld	D 1.7 (1.5) Ld
Grade 60	fy=60,000 psi f 'c=4,000 psi (Class S Concrete)			
#4	1' – 5"	2' – 1"	1' – 9"	2' – 7"
#5	1' – 9"	2' – 7"	2' – 2"	3' – 3"
#6	2' – 1"	3' – 1"	2' – 7"	3' – 10"
Note that values in splice table are rounded up to next inch				

Table 1-14: Slab Splice Information

Description	Code
Slab reinforcing for designs based on bars spaced at 6" or more *	-
♦ 1.7 (0.8) Ld ~ slab splices for reinforcing spaced at 6" C-C or more	A
♦ 1.7 (0.8) 1.5 Ld ~ slab splices for reinforcing spaced 6" C-C or more (epoxy coated)	B
Slab reinforcing for designs based on bars spaced at less that 6" C-C	-
♦ 1.7 Ld ~ slab splices for reinforcing spaced less than 6" C-C	C
♦ 1.7 (1.5) Ld ~ slab splices for reinforcing spaced less than 6" C-C (epoxy coated)	D
* Conventional 8" slab used by the Bridge Division	

English Standard Bends – 90º Anchorage Hook

Main bars or secondary bars without another bar enclosed (Grades 40 and 60)

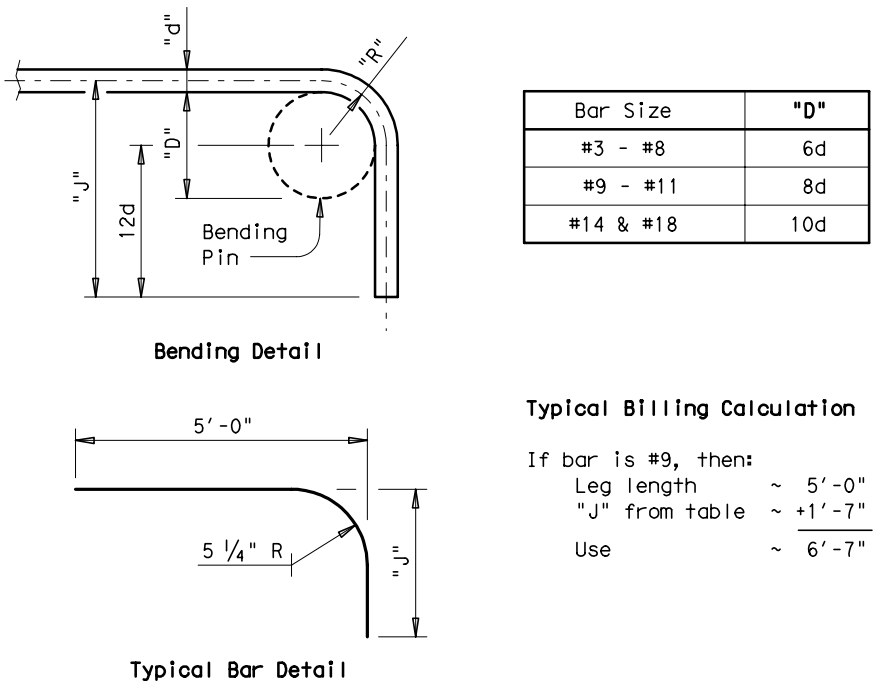


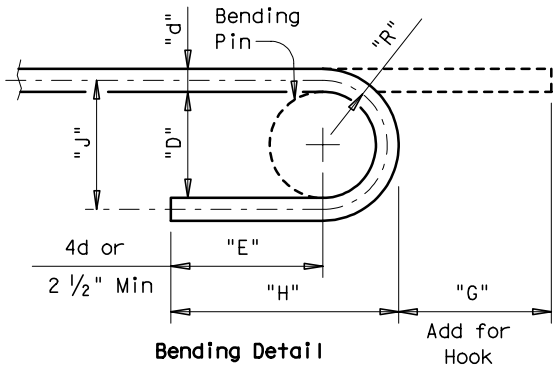
Figure 1-12: Standard Bends – 90º Anchorage Hook. Online users can click 1-12 to view this illustration in PDF.

Table 1-15: 90º Anchorage Hook Information

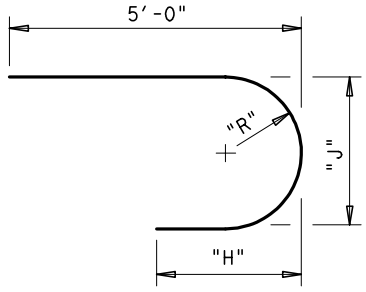
Size	d Bar Diameter	D Pin Diameter	R (D + d) / 2 rounded up to next 0.25 inch	J 12d + R rounded up to next inch
#3	0.375"	2.250"	1 1/2"	6"
#4	0.500"	3.000"	1 3/4"	8"
#5	0.625"	3.750"	2 1/4"	10"
#6	0.750"	4.500"	2 3/4"	1' – 0"
#7	0.875"	5.250"	3 1/4"	1' – 2"
#8	1.000"	6.000"	3 1/2"	1' – 4"
#9	1.128"	9.024"	5 1/4"	1' – 7"
#10	1.270"	10.160"	5 3/4"	1' – 9"
#11	1.410"	11.280"	6 1/2"	2' – 0"
#14	1.693"	16.930"	9 1/2"	2' – 6"
#18	2.257"	22.570"	1' – 0 1/2"	3' – 4"

English Standard Bends – 180º Anchorage Hook

Main bars or secondary bars without another bar enclosed (Grades 40 and 60)



Bar Size	"D"
#3 - #8	6d
#9 - #11	8d
#14 & #18	10d



Typical Billing Calculation

If bar is #9, then:

Leg length	~	5'-0"
"G" from table	~ +	1'-4"
Use	~	6'-4"

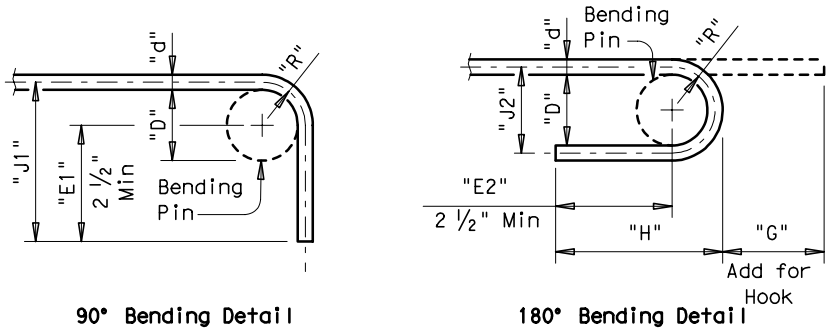
Figure 1-13: Standard Bends – 180º Anchorage Hook. Online users can click 1-13 to view this illustration in PDF.

Table 1-16: 180º Anchorage Hook Information

Size	d Bar Diameter	D Pin Diameter	J 2 R rounded up to next 0.25 inch	H E + R rounded up to next inch	G (π R) + H – J rounded up to next 0.25 inch
#3	0.375"	2.250"	2 3/4"	4"	5 3/4"
#4	0.500"	3.000"	3 1/2"	5"	7"
#5	0.625"	3.750"	4 1/2"	5"	7 3/4"
#6	0.750"	4.500"	5 1/4"	6"	9"
#7	0.875"	5.250"	6 1/4"	7"	10 3/4"
#8	1.000"	6.000"	7"	8"	1' – 0"
#9	1.128"	9.024"	10 1/4"	10"	1' – 4"
#10	1.270"	10.160"	11 1/2"	11"	1' – 5 1/2"
#11	1.410"	11.280"	1' – 0 3/4"	1' – 1"	1' – 8 1/2"
#14	1.693"	16.930"	1' – 6 3/4"	1' – 5"	2' – 3 3/4"
#18	2.257"	22.570"	2' – 1"	1' – 10"	3' – 0 1/2"

English Standard Bends – Stirrup and Tie Bars

Enclosing another bar within the bend (Grades 40 and 60)



Bar Size	"D"	"E1"	"E2"
#3 - #5	4d	6d	4d
#6 - #8	6d	12d	4d

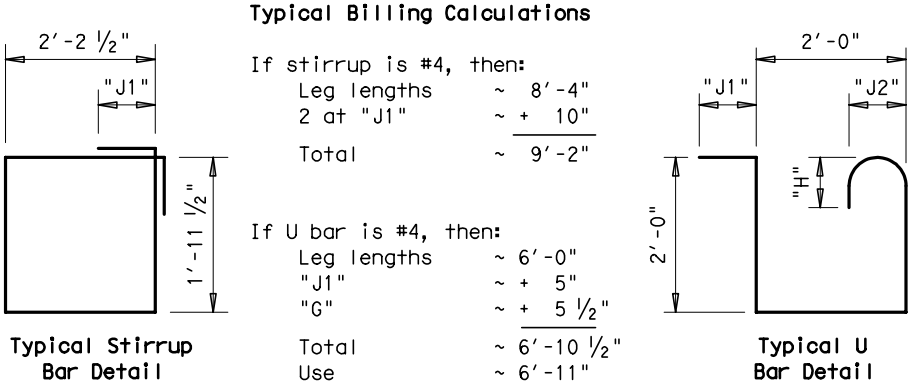


Figure 1-14: Standard Bends – Stirrup and Tie Bars. Online users can click 1-14 to view this illustration in PDF.

Table 1-17: Stirrup and Tie Bar Information

Size	D Bar Diameter	D Pin Diameter	J1 E1 + R rounded up to next inch	J2 2R rounded up to next 0.25 inch	H E2 + R rounded up to next inch	G (π R) + H – J2 rounded up to next inch
#3	0.375"	1.500"	4"	2"	4"	5 1/4"
#4	0.500"	2.000"	5"	2 1/2"	4"	5 1/2"
#5	0.625"	2.500"	6"	3 1/4"	5"	7"
#6	0.750"	4.500"	1' – 0"	5 1/4"	6"	9"
#7	0.875"	5.250"	1' – 2"	6 1/4"	7"	10 ¾"
#8	1.000"	6.000"	1' – 4"	7"	8"	1' – 0"

Cover Requirements

The minimum clear cover from the face of concrete to the face of the bar shall be as shown in Table 1-18. The usual centerline cover as given may require adjustment if a bar larger than normal is used. Exposure to sea water, sea spray, or road salt may also be cause for increasing these values. See individual chapters for normal or recommended bar sizes for each type of structure.

Table 1-18: Cover Requirements

-	Cover		
Location in Structure	**Min Clear**	**Usual Centerline ***	**End Clear**
Slabs	-	-	-
♦ Longitudinal bars	-	-	2"
♦ Transverse bars	-	-	1 1/2"
♦ Top bars	2	-	-
♦ Bottom bars	1 1/4"	-	-
Beams (except prestressed)	-	-	-
♦ Main steel	-	-	2
♦ Ties and stirrups	2"	2 1/4"	-
Abutment	-	-	-
♦ Main steel	-	-	6"
♦ Stirrups top and sides	2"	2 1/4"	-
♦ Stirrups bottom	3"	3 1/4"	-
Interior bents	-	-	-
♦ Main steel	-	-	2
♦ Stirrups	2	2 1/4"	-
Walls	-	-	-
♦ Unformed face (cast against earth)	3	3 1/2"	3
♦ Formed face (including backfilled)	2	2 1/4"	2
Columns and drilled shafts	-	-	-
♦ Stirrups and spirals	2 3/4"	3"	-
Footings	-	-	-
♦ Top	2"	2 1/4"	2"
♦ Sides	3"	4"	2"
♦ Bottom	3"	3 3/4"	2"
Delicate castings (rails, etc.)	1 1/2"	1 3/4"	1 1/2"
Bearing seat pedestals	2"	2 1/4"	1 1/2"

* Reference TxDOT Standards Specification Manual, Item 440.8:
2 1/4" and 3 1/4" centerline dimensions for #4 and #5 bars.
2 1/2" and 3 1/2" centerline dimensions for #6 and #7 bars.

Section 7
Foundations

FD Standard

The foundation details (FD) sheet contains information on drilled shafts, piling, and concrete footings. Unless specially designed foundations are required, this sheet shall normally be included with the detail sheets prepared by the designer. If the FD sheet is included, it will not be necessary to include foundation details on the substructure details sheets. The following general note referencing the FD sheet shall be included on the detail sheets:

"See Foundation Details standard sheet, FD, for all foundation details and notes."

Drilled Shafts

Table 1-19: Drilled Shaft Reinforcing

-	Vertical Reinforcing		Spiral Reinforcing		
Shaft Diameter	**No. of Bars**	**Size**	**Size**	**Pitch**	**Dia**
18"	6	#6	#3	6"	1' – 0"
24"	8	#7	#3	6"	1' – 6"
30"	8	#9	#3	6"	2' – 0"
36"	10	#9	#3	6"	2' – 6"
42"	14	#9	#3	6"	3' – 0"
48"	18	#9	#3	6"	3' – 6"
54"	16	#11	#4	9"	4' – 0"
60"	20	#11	#4	9"	4' – 6"
66"	22	#11	#4	9"	5' – 0"
72"	26	#11	#4	9"	5' – 6"

Concrete Piling

Table 1-20: Common Conc Piling Sizes

14"
15"
16"
18"
20"
24"

Chapter 2
Layouts and Estimated Quantities

Contents:

Section 1
General Information

Bridge Layouts

Bridge layouts are a pictorial representation of what the bridge looks like. Bridge layouts should be drawn accurately and commensurate with the clarity of presentation. For example, the bridge slab depth may need to be exaggerated in the elevation view.

The Bridge Layout Sheet shall contain, but is not limited to, the following listed details:

- Plan View - normally shown in ascending stations from left to right
- Elevation View - normally shown as a section through the profile grade line or control line and should be visually aligned with the plan view
- Typical Transverse Section - showing only the superstructure. Not required when Staged or Phased Construction Sheet is included.

The Bridge Layout Sheet shall be detailed using one of the following listed scales for both horizontal and vertical:

- 1" = 20'
- 1" = 10'

NOTE: Do not mix horizontal scales and vertical scales.

These scales are for full-size English sheets (22" x 34"). For plotting in half-size English sheets (11" x 17"), the scales translate to 1" = 40' and 1" = 20', respectively.

Dimensioning tolerances shall normally be shown on the Bridge Layout Sheet as listed below:

- Structural dimensions - bridge and rail lengths on plan view in decimal feet to the neartest 0.01'. Widths on plan and transverse section views in feet and inches to the nearest 1/4" (all decimals are acceptable, and preferred, on complex structures).
- Piling or Drilled Shafts - in feet rounded up to the next whole foot for lengths and in inches for the pile and drill shaft size
- Columns - in feet rounded up to the next whole foot
- Elevations - in decimal feet to the nearest 0.001'
- Bearings and Angles - in degrees, minutes, seconds to the nearest whole second if such accuracy is available
- Stations - in decimal feet to the nearest 0.01'

The most accurate representations on a bridge layout are the profile grade line (or control line) in the plan view and the ground line on the elevation view. The ground line at the column locations may be scaled from the layout elevation view grid pattern. This elevation

may then be used, along with the calculated bearing seat elevations, calculated cap depths, desired depth of foundations below ground, etc., to determine the column heights. The column heights should not be measured directly off of the layout.

All computer-aided drawing (CAD) files for TxDOT jobs must be created with MicroStation and utlilizing TxDOT's customized font library or font resource file, furnished by the Bridge Division. Only Font 1 should be used for generating text in a set of plans.

Section 2

Proper Titles for Bridge Layouts

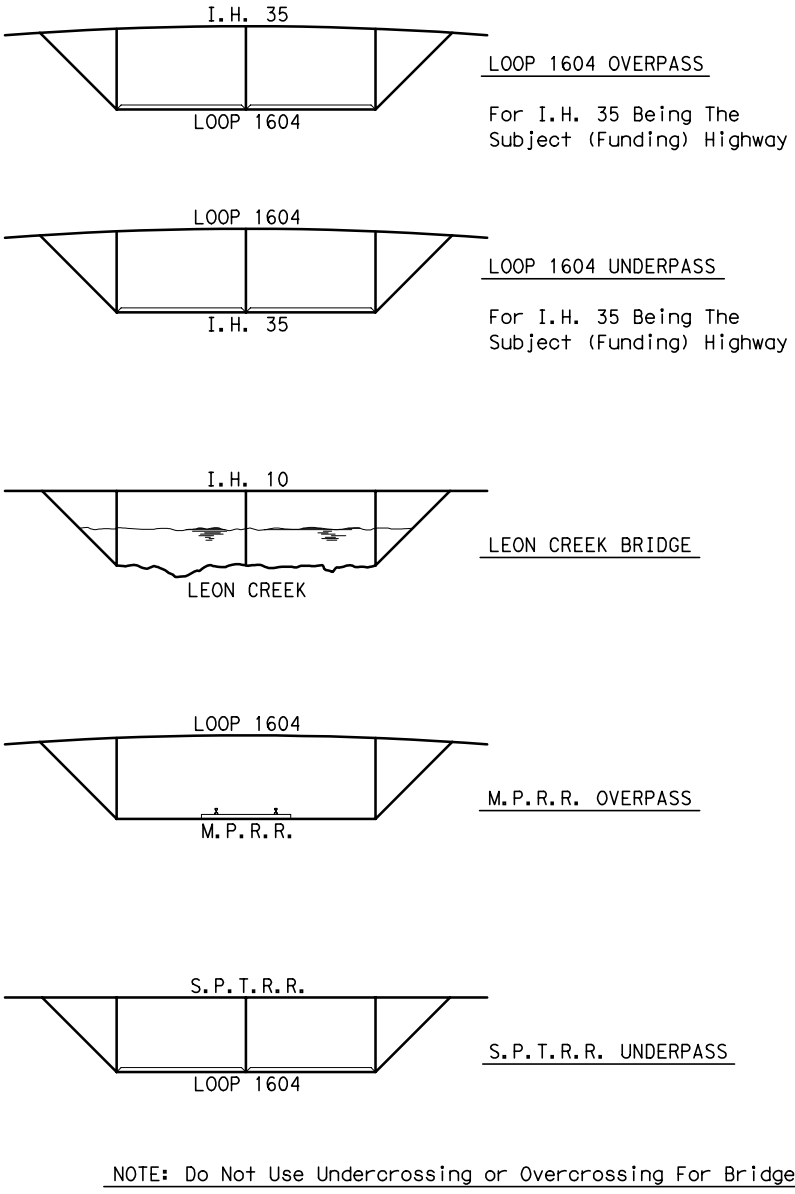


Figure 2-1: Proper Titles for Bridge Layouts. Online users can click 2-1 to view this illustration in PDF.

Section 3
Layout Sheets

Bridge Layout Examples

The following examples are included to provide the drafting layout of a typical Bridge Layout Sheet. See the various sections of this chapter for directions on drawing particular details.

Underpass Example

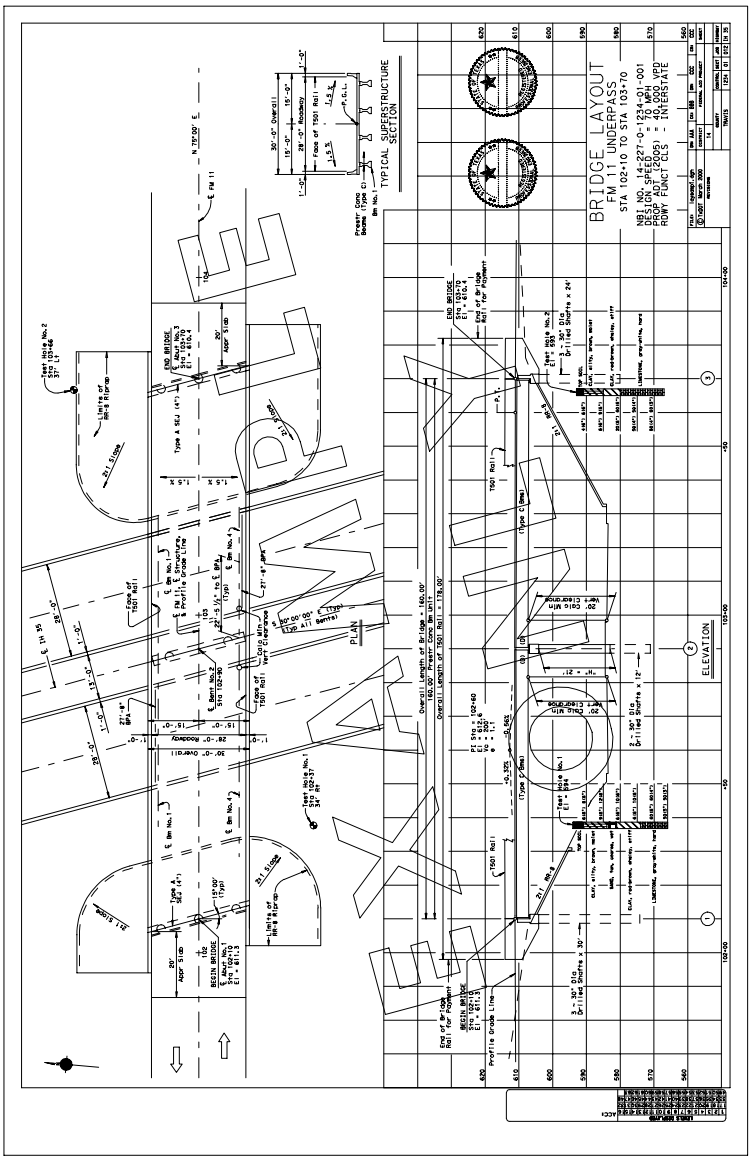


Figure 2-2: Underpass Example. Online users can click 2-2 to view this illustration in PDF.

Stream Crossing Example

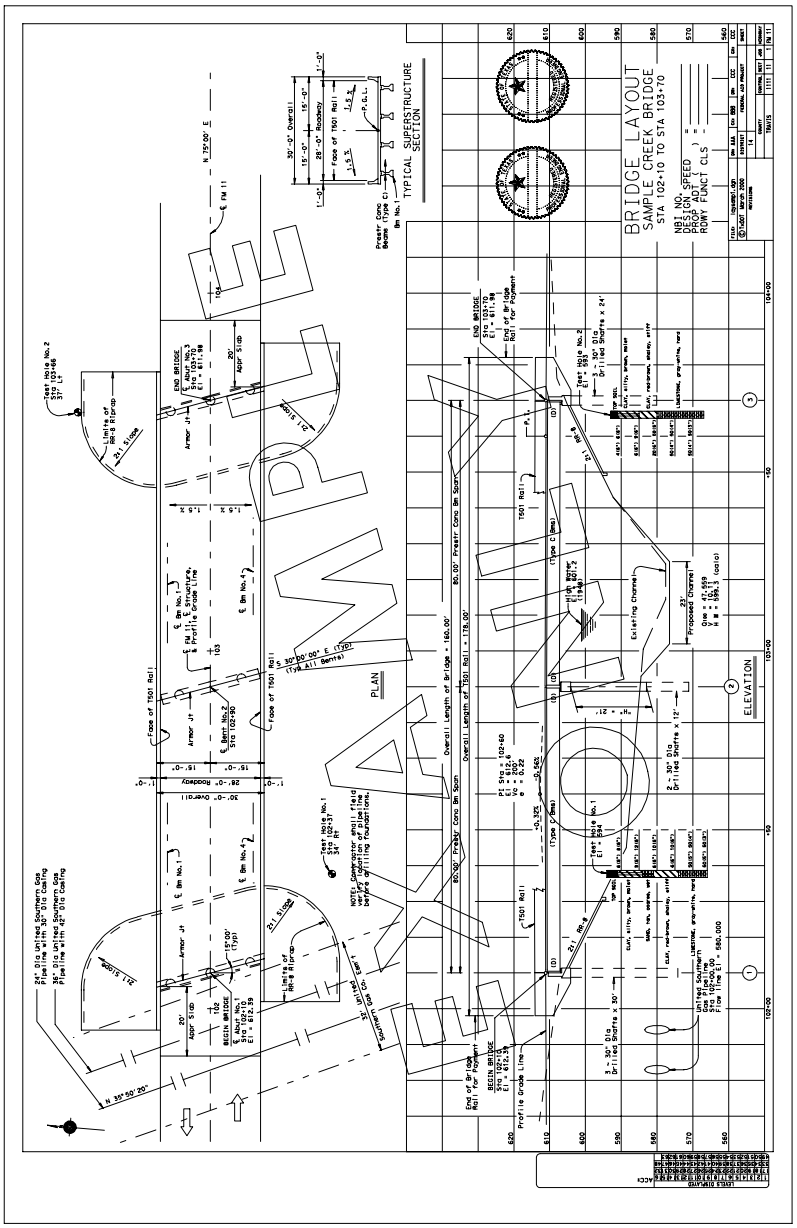


Figure 2-3: Stream Crossing Example. Online users can click 2-3 to view this illustration in PDF.

Railroad Overpass Example

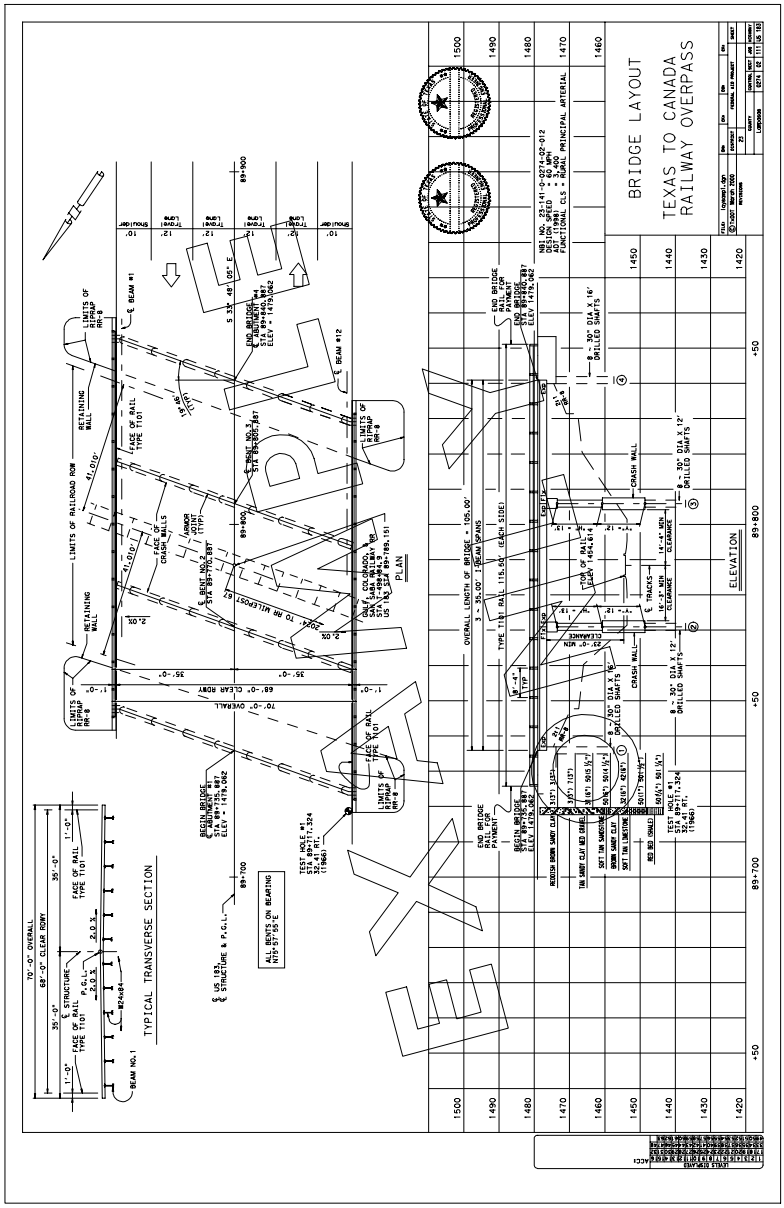


Figure 2-4: Railroad Overpass Example. Online users can click 2-4 to view this illustration in PDF.

Railroad Underpass Example

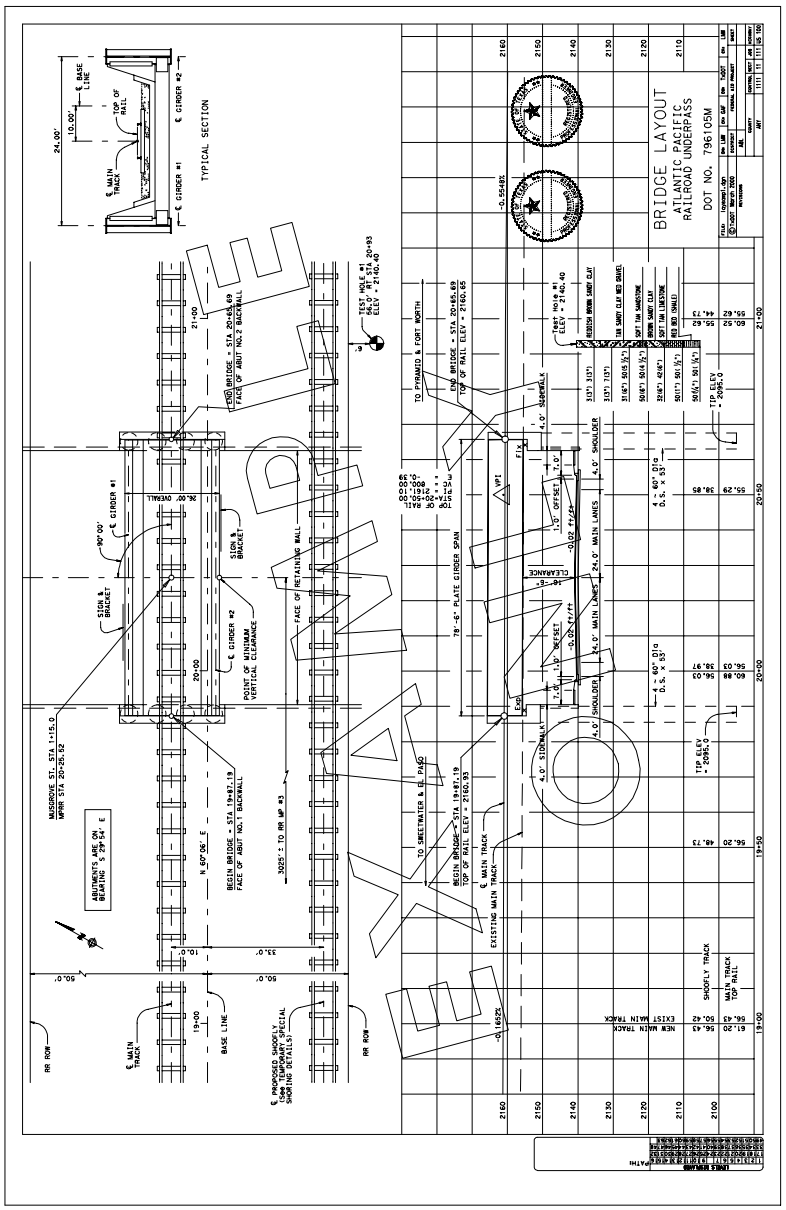


Figure 2-5: Railroad Underpass Example. Online users can click 2-5 to view this illustration in PDF.

Section 4
Bridge Layout Sheet Checklist

Preliminary Data Required

1. ☐ Profile grade data and location (horizontal and vertical curve data)
2. ☐ Bearing of centerline or reference line
3. ☐ Skew angle
4. ☐ Control stations (begin and end bridge, bents, intersections, etc.) for railroad underpass and railroad overpass : RR sta = roadway station at intersection of railroad and roadway control lines (See comments under "Plan View.")
5. ☐ Bridge roadway width, shoulders, sidewalks, etc.
6. ☐ Soil exploration data (test holes, identifications, locations, etc.)
7. ☐ Profile of crossing and estimated vertical clearances to all lower roadways and railroad tracks
8. ☐ Critical horizontal clearances (locations of railroad tracks, utilities, culverts, nearby structures, etc.)
9. ☐ Amount and method of varying superelevation and/or crown
10. ☐ Railing type
11. ☐ Contours at crossing (when applicable)
12. ☐ Header bank slope and approach fill
13. ☐ Approach slab and curb returns
14. ☐ Limits and type of riprap
15. ☐ Approach pavement and crown width
16. ☐ Traffic direction and stream flow
17. ☐ North arrow
18. ☐ Right of way (if required)
19. ☐ Overall length of structure
20. ☐ Lengths and types of units/spans

21. ☐ Existing and proposed ground line

22. ☐ Hydraulics data (100-year and design flood elevation and velocities)

23. ☐ New structure National Bridge Inventory (NBI) number, design speed, Average Daily Traffic (ADT) and year (existing and/or proposed) and functional class of roadway are required for a typical bridge or overpass. For a railroad overpass, **NBI** and railroad milepost required. For a railroad underpass, Department of Transportation (DOT) number and railroad milepost required.

24. ☐ Existing structure shown (dashed) on plan view and existing **NBI** number for bridge replacement

25. ☐ For widenings, show existing structure on plan view, existing **NBI** number, and make sure the overall and roadway widths of both existing and new structures are shown. The designers will set the actual break line. See Figure 5-16 under Miscellaneous Slab Information in Chapter 5.

26. ☐ For staged (or phased) construction information, see Figure 5-15 under Miscellaneous Slab Information in Chapter 5.

27. ☐ Railroad overpass and railroad underpasses: Because individual railroad requirements may differ, the particular railroad involved should be contacted regarding any additional requirements. This effort must be coordinated through TxDOT personnel knowledgeable in railroad issues.

28. ☐ If Form 1002 " **PS&E** Submission Data" (page 3 of 3) has not been submitted, it must be completed and sent with the preliminary layout.

Completed Layout

Plan View

1. ☐ Reference line, centerline, or profile grade line (bearing, location, and station). Railroad overpass and railroad underpass shall also have the railroad station (RR Sta) at intersection of railroad and roadway control lines.
2. ☐ Begin and end bridge stations and elevations
3. ☐ All bent numbers, stations, and bearings
4. ☐ Deck joint type, locations, and size of seal (if used). If a sealed expansion joint (SEJ) is used, give SEJ type and size.
5. ☐ Widths (overall, roadway, shoulders, etc.)
6. ☐ Traffic direction and stream flow
7. ☐ North arrow
8. ☐ Test holes, identifications, locations, etc.
9. ☐ Dimensions to features that control vertical and horizontal clearances (indicate points of minimum clearances as required, for structures, utilities, railroad tracks, etc.)
10. ☐ Right of way (if required)
11. ☐ Horizontal curve data
12. ☐ Cross slope
13. ☐ Type and limits of riprap (and blockouts, if required)
14. ☐ Skew angle
15. ☐ Railing type
16. ☐ Beam line numbers (consistent with span details)
17. ☐ Approach pavement and dimensions
18. ☐ Bridge protection assembly locations
19. ☐ Show foundation type and location. See Figure 3-6 in Chapter 3, Foundation Parameters and Calculations , for orientation of batter for outside piling groups on abutments.

Additional information not shown on examples

20. ☐ Locate bridge drain and/or bridge lighting bracket stations on plan view, when applicable.

21. ☐ Existing structure should be shown (dashed) on plan view, with existing National Bridge Inventory (NBI) number shown for bridge replacements or railroad milepost for a railroad underpass.

22. ☐ For widenings, show existing structure on plan view, existing **NBI** number, and make sure the overall and roadway widths of existing and new structures are shown. The designers will set the actual break line.

23. ☐ For staged (or phased) construction information, show dimension to stage construction joints.

Elevation View

1. ☐ Overall length of structure
2. ☐ Lengths and types of units/spans
3. ☐ Overall length and type of railing for each side (and, if required, median barrier) "End of Bridge Rail for Payment" note at both ends (for Type T6 rail, follow instructions on standard)
4. ☐ Vertical curve data and grade
5. ☐ Begin and end bridge stations (at face of abutment backwall) and elevations
6. ☐ Doweled beam locations
7. ☐ Minimum calculated vertical clearances to all lower roadways and railroad tracks (and other clearances as required, such as utilities, nearby structures, etc.). Railroad overpass: minimum horizontal clearance from centerline track to face of interior bent columns, crash wall, retaining wall, or other obstructions.
8. ☐ Control or profile grade line
9. ☐ Existing and proposed ground lines
10. ☐ Hydraulics data (100-year and design flood elevations and velocities)
11. ☐ Grid elevations and stations
12. ☐ "H" heights
13. ☐ Types, number, sizes, and lengths of foundations (and, if required, direction of pile batter and orientation of footings on elevation and plan views)
14. ☐ Test hole elevation views and data
15. ☐ Bent numbers (encircled)
16. ☐ Special foundation notes (if required by geotechnical engineers)
17. ☐ Riprap type

Typical Transverse Section

1. ☐ Widths (overall, roadway, shoulders, sidewalks, etc.)
2. ☐ Profile grade line and/or horizontal control line
3. ☐ Cross slope
4. ☐ Dimension to stage construction joints for widening or stage construction projects. See Figure 5-15 and Figure 5-16 under Miscellaneous Slab Information in Chapter 5.
5. ☐ Railing
6. ☐ Beam type and numbers (if required)

Final Checks

1. ☐ Standards layout title with National Bridge Inventory (NBI) number (and Department of Transportation number for railroad overpass), design speed, Average Daily Traffic (ADT) and year (existing and/or proposed), and functional class of roadway
2. ☐ Dimensions and scales conform to grid (and elevations)
3. ☐ Compare layout detail views against all bridge structural details for compatibility
4. ☐ Check foundations against structural details
5. ☐ Engineer's seal

Section 5
Normal Parameters

Bridge Layout Parameters

Normal layout parameters are as follows:

- 1' - drilled shaft and piling length increments
- 1' - column height increments

- 24'-0" - standard roadway width
- 28'-0" - standard roadway width
- 30'-0" - standard roadway width
- 38'-0" - standard roadway width
- 44'-0" - standard roadway width

- 1'-0" - nominal face of rail from edge of slab
- 4" or 5" - sealed expansion joint

Section 6
Plan View

Plan View Example

The plan view checklist, presented in Section 4, should be followed to ensure that the details are accurate and complete.

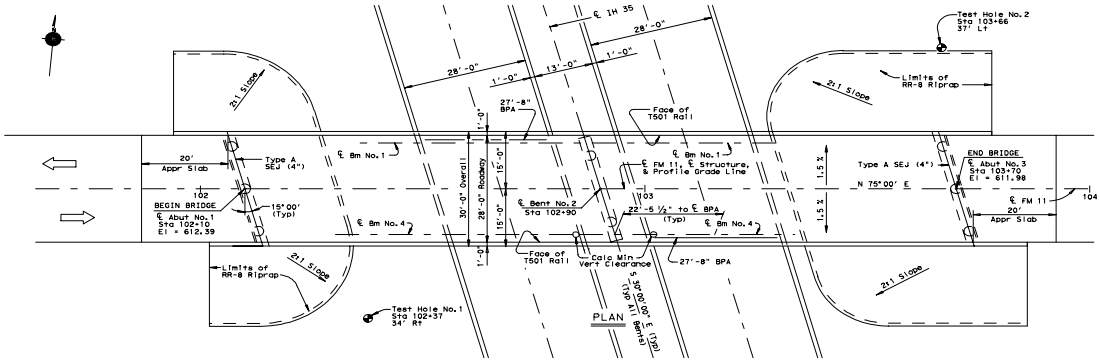


Figure 2-6: Plan View Example. Online users can click 2-6 to view this illustration in PDF.

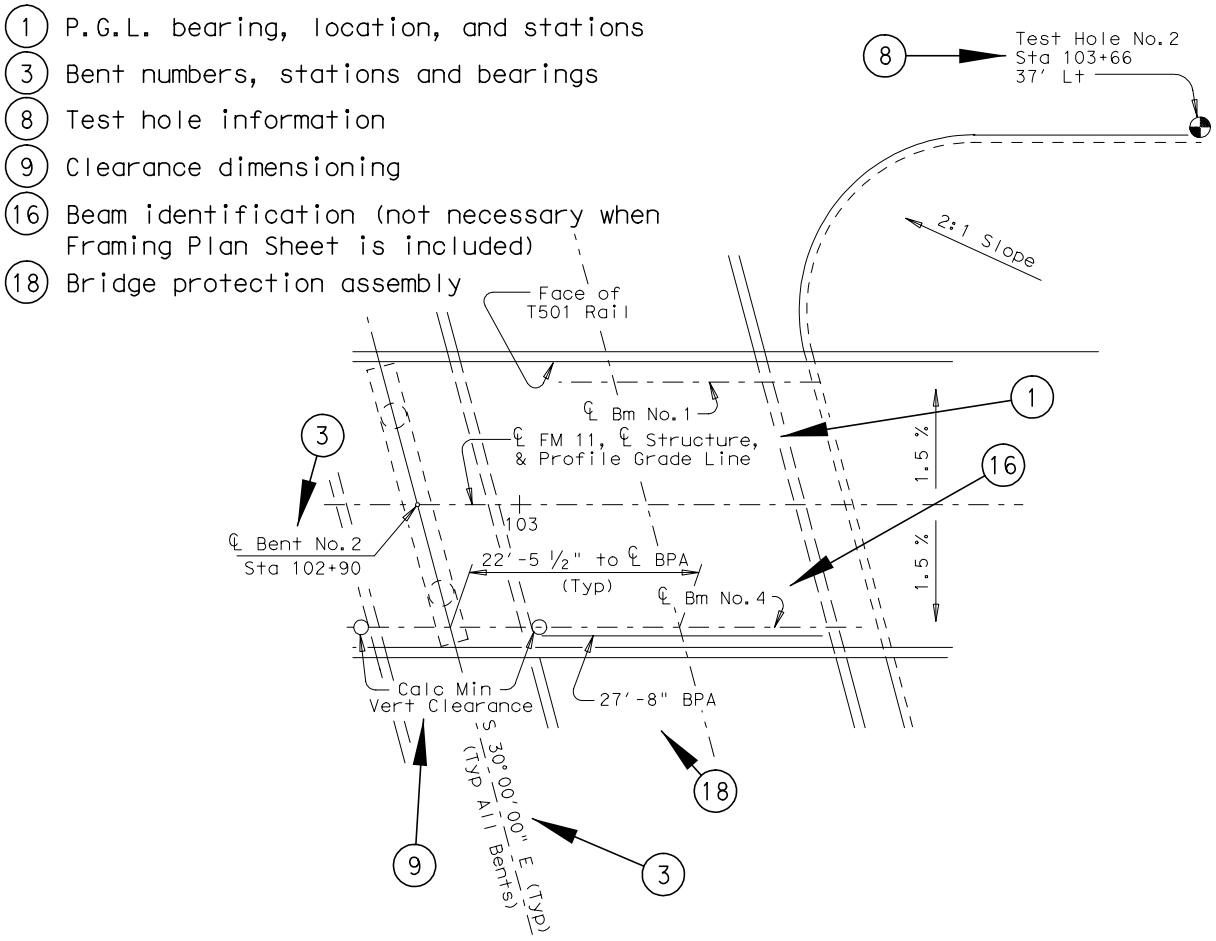


Figure 2-7: Partial Interior Plan View, Checklist Items. Online users can click 2-7 to view this illustration in PDF.

(2) Begin bridge information
(4) Deck joint information
(5) Structure widths
(6) Traffic direction
(7) North arrow
(12) Cross slope
(13) Riprap information
(14) Skew angle
(15) Railing information
(17) Approach information
(19) Foundation type and location

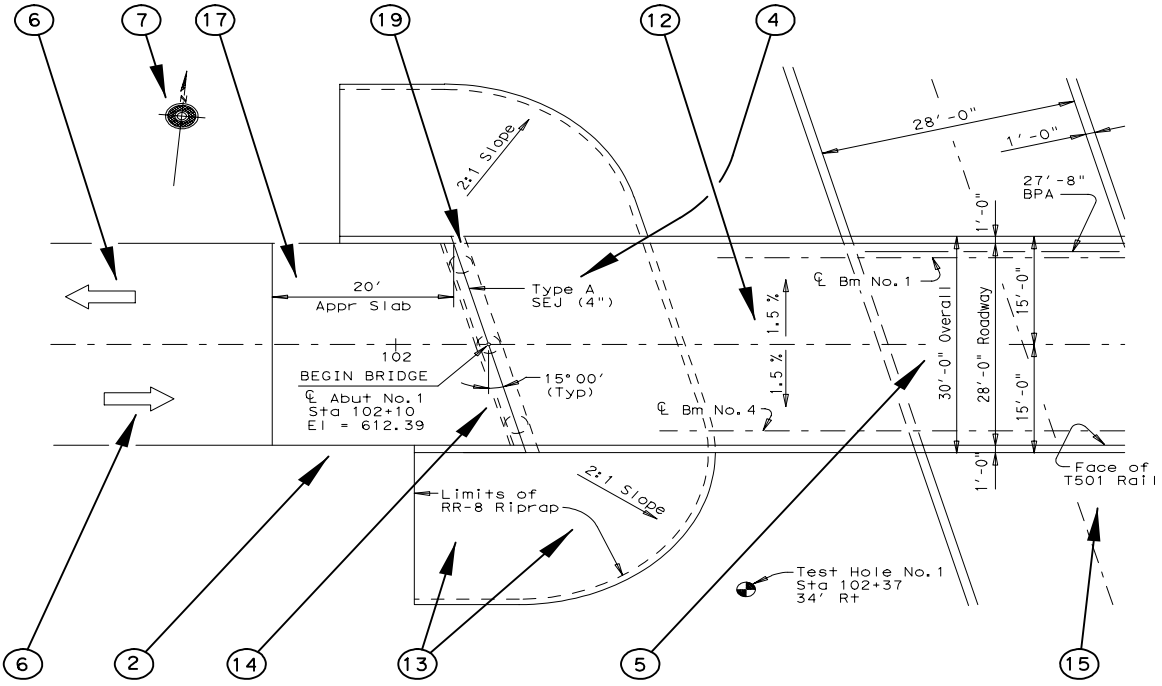


Figure 2-8: Partial End Plan View, Checklist Items. Online users can click 2-8 to view this illustration in PDF.

Section 7
Elevation View

Elevation View Example

The elevation view checklist, presented in Section 4, should be followed to ensure that the details are accurate and complete.

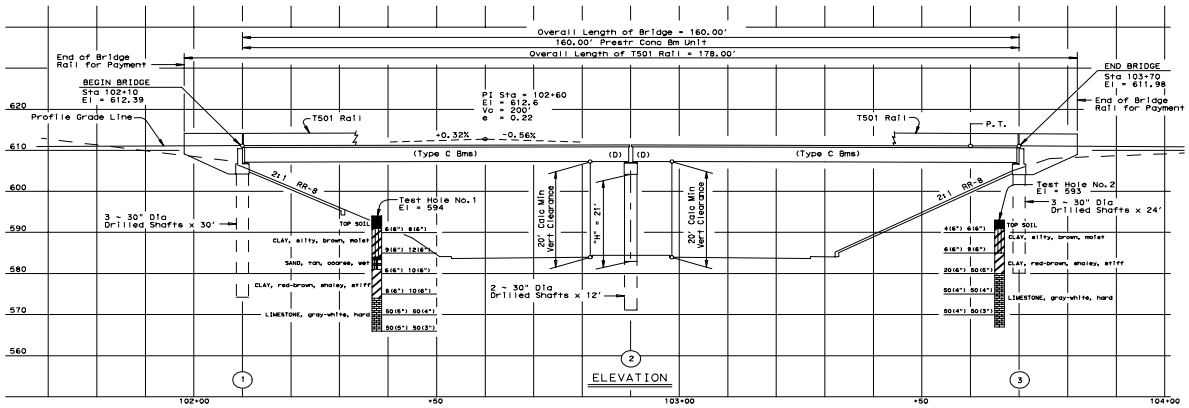


Figure 2-9: Elevation View Example. Online users can click 2-9 to view this illustration in PDF.

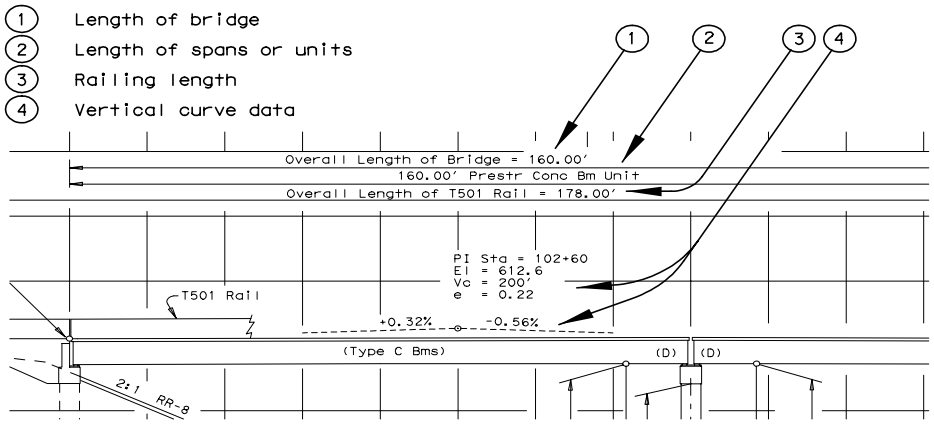
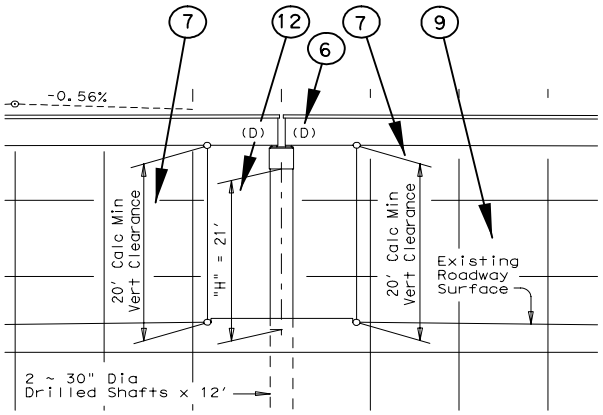


Figure 2-10: Above Structure Elevation View, Checklist Items. Online users can click 2-10 to view this illustration in PDF.

(3) Railing information
(5) Begin bridge information
(6) Beam dowel locations
(7) Calculate clearances
(8) Grade information
(9) Ground lines
(11) Grid elevation and stations
(12) "H" height
(13) Foundation information
(15) Bent numbers
(17) Riprap information



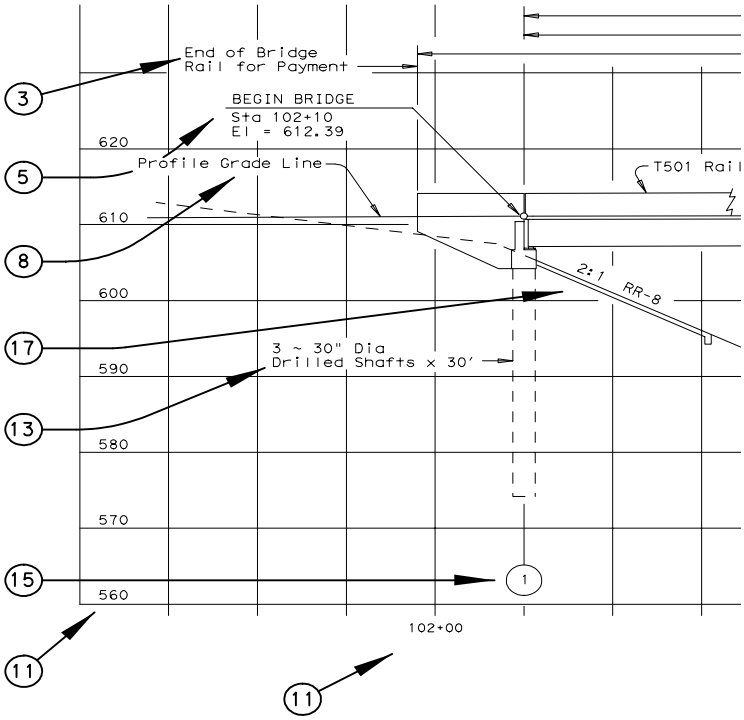


Figure 2-11: On Structure Elevation Views, Checklist Items. Online users can click 2-11 to view this illustration in PDF.

Section 8
Test Hole/Boring Details

Test Hole Introduction

When detailing a test hole or boring detail, it is not necessary to show every change that appears on the boring log sheet. Differentiate particular soil and bedrock formations, using appropriate symbology and descriptions, only when there are significant differences between layers. In addition to describing the kind and condition of a formation, include its color and natural moisture state (dry, moist, saturated, etc.). For additional test hole or boring information, refer to the Geotechnical Manual .

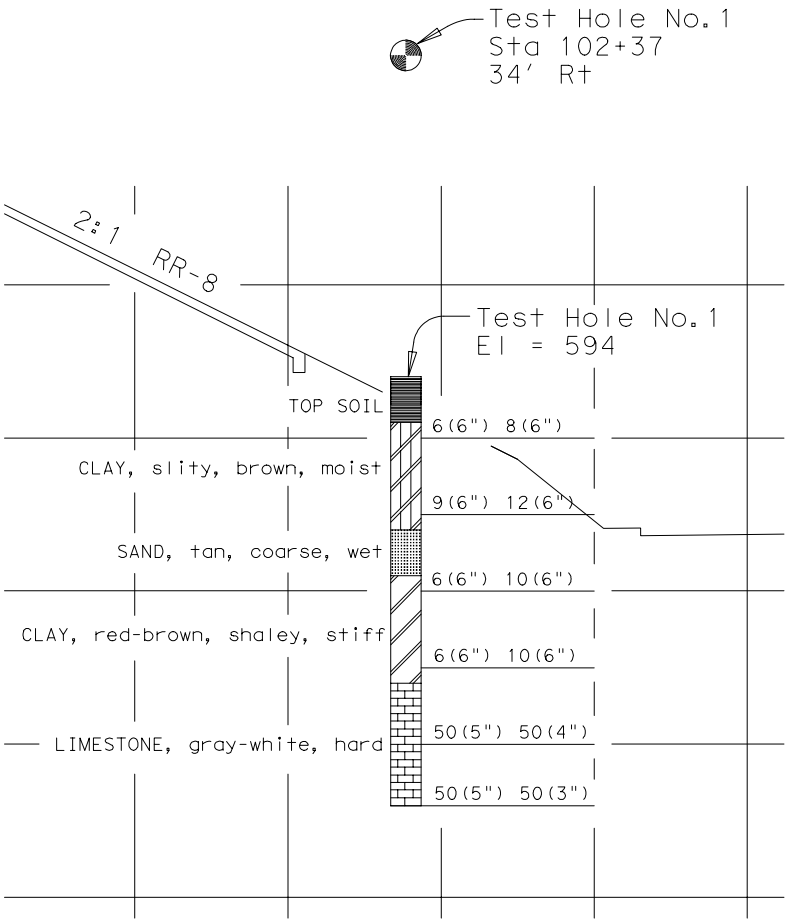


Figure 2-12: Test Hole Example. Online users can click 2-12 to view this illustration in PDF.

Table 2-1: Soil and Bedrock Classifications

Bedrock	Igneous	Granite Basalt	
	Metamorphic	Gneiss Schist Slate Marble	
	Sedimentary	Clastic	Shale (Claystone) Siltstone Limestone Sandstone Glauconite Conglomerate Lignite
Soils	Cohesive	Clay	
	Cohesionless	Silt Sand Gravel	

Table 2-2: Soil and Bedrock Standard Names

Soil and Bedrock	Common Modifiers	Color
Basalt	Calcareous	Black
Boulder	Clayey	Blue
Calcite	Fine	Brown
Conglomerate	Hard	Dark
Chalk	Large	Gray
Chert	Medium	Green
Clay	Moist	Light
Claystone	Nodules	Red
Cobble	Organic	Tan
Dolomite	Sandy	White
Glauconite	Shaley	Yellow
Gneiss	Silty	
Granite	Slickensided	
Gravel	Small	
Gypsum	Soft	
Halite	Wet	
Lignite		
Limestone		
Marble		
Redbed		
Schist		
Sand		
Shale		
Silt		
Siltstone		
Sandstone		

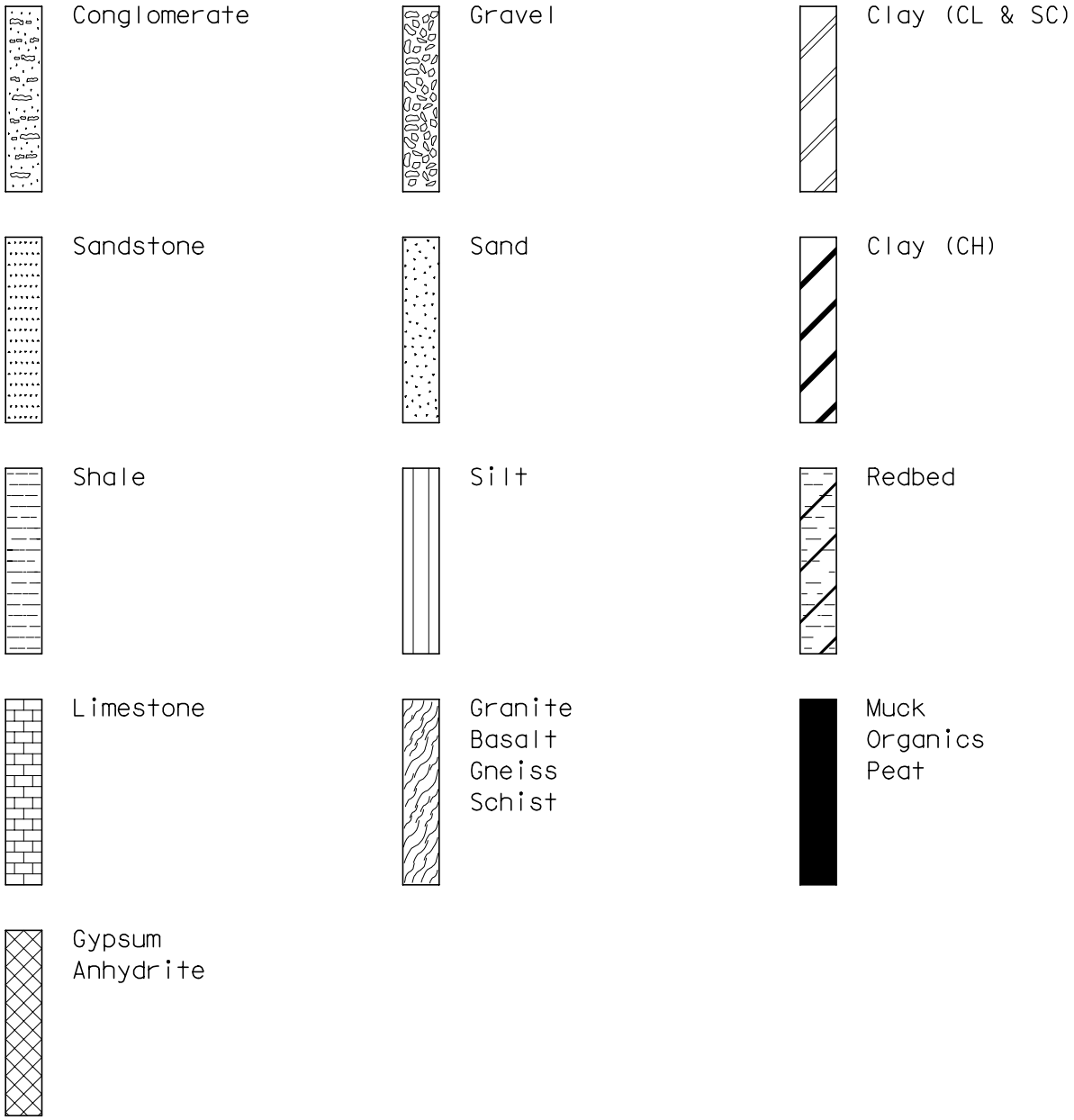
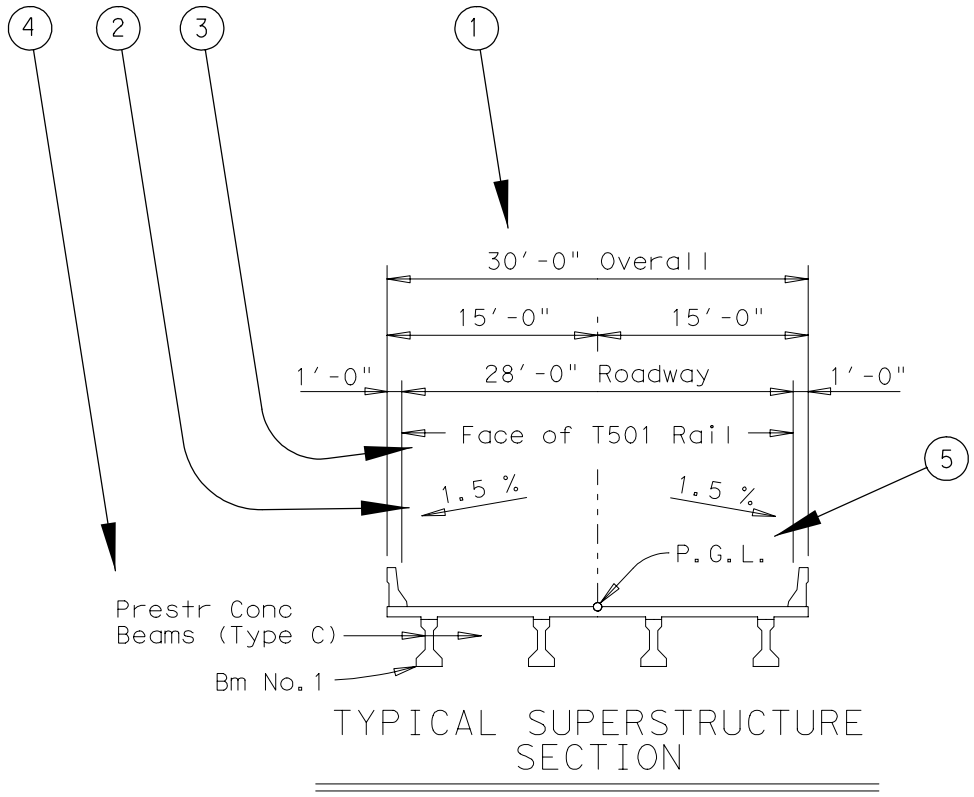


Figure 2-13: Soil and Bedrock Symbology. Online users can click 2-13 to view this illustration in PDF.

Section 9
Typical Transverse Section

Transverse Section Example

These details are included only as examples of a typical transverse section and are not intended to accurately reflect any particular structure. The typical transverse section checklist, presented in Section 4, should be followed to ensure that the details are accurate and complete.



1. Width dimensioning
2. Cross Slope
3. Railing information
4. Beam information
5. Profile Grade Line and/or Horizontal Control Line

Figure 2-14: Typical Transverse Section, Checklist Item. Online users can click 2-14 to view this illustration in PDF.

Section 10
Title Block

Title Block Example

Title blocks have considerable variation in both contents and appearance. The example shown below is typical of the form commonly used in bridge plans. (See Figure 1-8 in Chapter 1, Section 5, for the line weights and text sizes used in the title.)

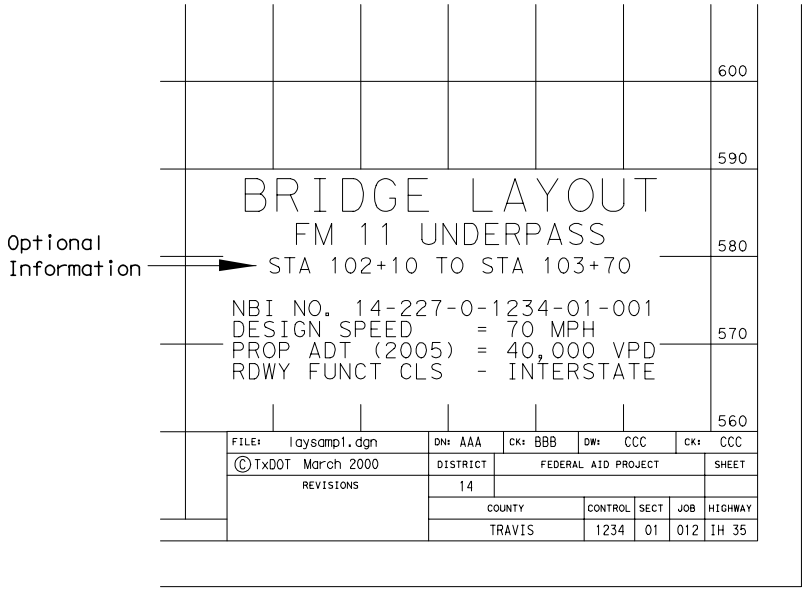


Figure 2-15: Title Block Example. Online users can click 2-15 to view this illustration in PDF.

Section 11
Estimated Quantities Sheet

Estimated Quantities Sheet Example

The table of estimated quantities shall be included with the detail sheets. The table of bearing seat elevations, if applicable, should be placed on the sheet with the estimated quantities. This sheet is included to provide an example of the drafting layout of a typical Estimated Quantities Sheet. See the various sections of this chapter for directions on filling out the table and displaying the bearing seat elevation information.

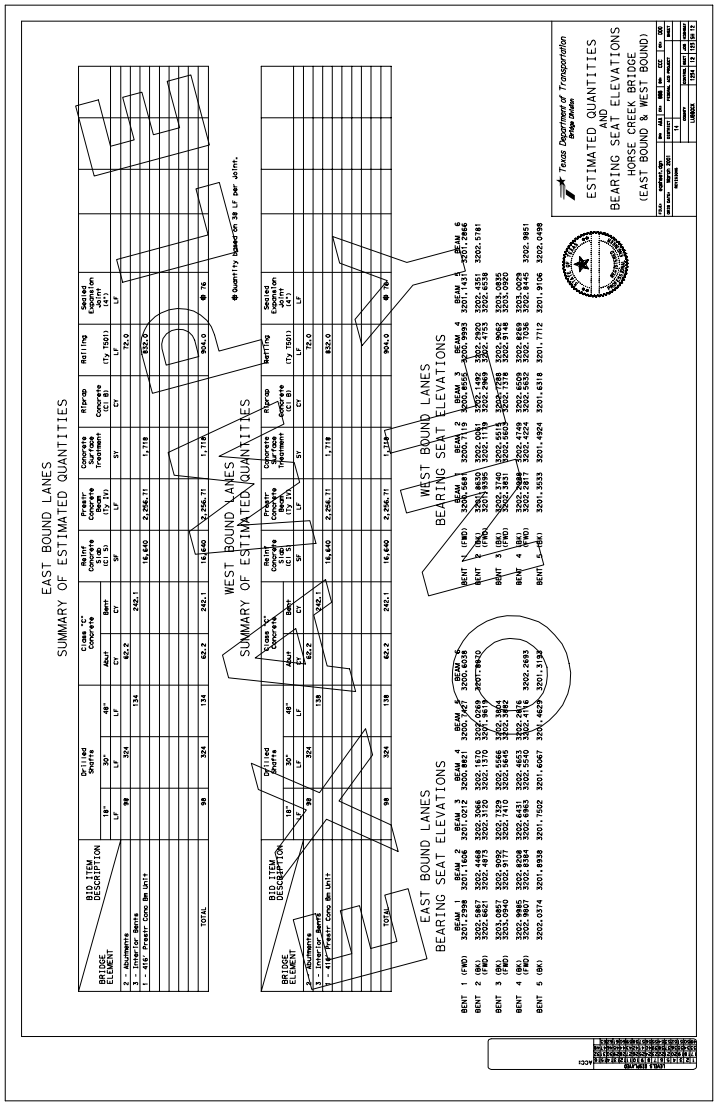


Figure 2-16: Estimated Quantities Sheet Example. Online users can click 2-16 to view this illustration in PDF.

Section 12
Table of Estimated Quantities

Table of Estimated Quantities Example

When filling out the Table of Estimated Quantities, elements listed under the "BRIDGE ELEMENT" shall generally be placed in construction sequence order, substructure items preceding superstructure items. Items following "BID ITEM DESCRIPTION" shall be placed in sequence by increasing bid item number. Item descriptions should generally conform to those shown in the current list of bid codes available on the TxDOT web site and shall be measured in the units given therein. Any items listed that are for contractor's information only must be labeled as such.

NOTE: Quantities for structural steel at armor joints and sealed expansion joint lengths shall be omitted on Abutment and Span Sheets, with just the totals given on the Estimated Quantities Sheet. On complex structures, put an * by the quantity total. Below the table, break the quantities down for each abutment or bent where they occur.

BRIDGE ELEMENT / BID ITEM DESCRIPTION	Drilled Shafts		Class "C" Concrete		Reinf Concrete Slab (Cl S)	Prestr Concrete Beam (Ty IV)	Riprap Concrete (Cl B)	Concrete Surface Treatment	Railing (Ty T501)	Sealed Expansion Joint (4")
	18"	30"	Abut	Bent						
	LF	LF	CY	CY	SF	LF	CY	SY	LF	LF
2 - Abutments										
2 - Interior Bents										
2 - 55' Prestr Conc Bm Spans										
1 - 120' Prestr Conc Bm Unit										
TOTAL										

Figure 2-17: Table of Estimated Quantities Example. Online users can click 2-17 to view this illustration in PDF.

Bid Tolerances

Quantities shall be shown in the Table of Estimated Quantities to the accuracy listed in Table 2-3:

Table 2-3: Bid Tolerances

Common Item	Show to Nearest
Excavations	1 CY
Piling Length	1 LF
Drilled Shaft length	1 LF
Concrete	0.1 CY
Reinforced Concrete Slab	1 SF
Prestressed Concrete Beams	0.01 LF
Riprap	1 CY
Structural Steel	See Estimated Quantities in Chapter 6
Railing	0.1 LF
Sealed Expansion Joint	1 LF
Preformed Joint Seal	1 LF
Retaining Wall	1 SF
Concrete Surface Treatment	1 SY

Section 13

Bearing Seat Elevations

Bearing Seat Elevations Example

The elevations shown on the Table of Bearing Seat Elevations shall be given, at a minimum, to 0.001 feet. (Computer generated output tables, which normally show the elevations to four places, need not be rounded off to three places before use.) The format shown below shall generally be followed.

EAST BOUND LANES
BEARING SEAT ELEVATIONS

			BEAM 1	BEAM 2	BEAM 3	BEAM 4	BEAM 5	BEAM 6
BENT	1	(FWD)	3201.2998	3201.1606	3201.0212	3200.8821	3200.7427	3200.6038
BENT	2	(BK)	3202.5867	3202.4468	3202.3066	3202.1670	3202.0269	3201.8870
		(FWD)	3202.6621	3202.4873	3202.3120	3202.1370	3201.9619	
BENT	3	(BK)	3203.0857	3202.9092	3202.7329	3202.5566	3202.3804	
		(FWD)	3203.0940	3202.9177	3202.7410	3202.5645	3202.3882	
BENT	4	(BK)	3202.9985	3202.8208	3202.6431	3202.4653	3202.2876	
		(FWD)	3202.9807	3202.8384	3202.6963	3202.5540	3202.4116	3202.2693
BENT	5	(BK)	3202.0374	3201.8938	3201.7502	3201.6067	3201.4629	3201.3193

Figure 2-18: Bearing Seat Elevations Example. Online users can click 2-18 to view this illustration in PDF.

Chapter 3
Abutments

Contents:

Section 1
General Information

Preferred Abutment Scale

The Abutment Details Sheet shall normally contain, but is not limited to, the following listed details (showing preferred scales):

Table 3-1: Abutment Scales

Details	Preferred Scale
Plan View	3/8" = 1'-0"
Elevation View	3/8" = 1'-0"
Cap and Backwall Section	1/2" = 1'-0", 3/8" = 1'-0"
Wingwall Elevation and Section	1/2" = 1'-0", 3/8" = 1'-0"
Corner Details (Cap and Backwall)	1/2" = 1'-0"
Bar Details	3/4" = 1'-0", 1/2" = 1'-0"
Bearing Seat Detail	3/4" = 1'-0"
Table of Estimated Quantities	
General Notes	

Dimensions shall normally be shown on the abutment sheet as listed below:

- Structural dimensions and foundation locations - In the plan view, dimensions transverse to the roadway, wing lengths, and drilled shaft or piling locations in decimal feet to the nearest 0.001'. All other details, including dimensions across cap width in plan view, shall be shown in feet and inches to the nearest 1/4". (See Foundation Parameters and Calculations in Section 4 for shaft or pile group locations).
- Reinforcing steel - Rebar dimensions and locations in all views, including bar details, shall normally be in feet and inches to the nearest 1/4" at the centerline of the rebar.
- Cover - Cover on rebars shall normally be 2 1/4" to the centerline of the rebar. Cover on portions of reinforced concrete that are cast against exposed earth (as in the bottom of caps and wingwalls) shall normally be 3 1/4" centerline covers. The usual 2 1/4" centerline cover may require modification if rebars larger than #5 are used. (See Chapter 1, Section 6, for cover requirements for reinforcing steel).
- Angles - in degrees, minutes, seconds to the nearest whole second, if such accuracy is available

NOTE: For information about concrete slab and girder, box beam or double - T abutments, use Bridge Division standards as examples.

Section 2
Abutment Sheet

Abutment Example

This sheet is included to provide an example of the drafting layout of a typical Bridge Abutment Sheet. See the various sections of this chapter for directions on drawing particular details. Abutments are normally detailed looking at the face of backwall regardless of direction of increasing stations. The abutment at the beginning of the bridge will be shown facing the direction of decreasing stations, while the abutment at the end of the bridge will be shown facing the direction of increasing stations.

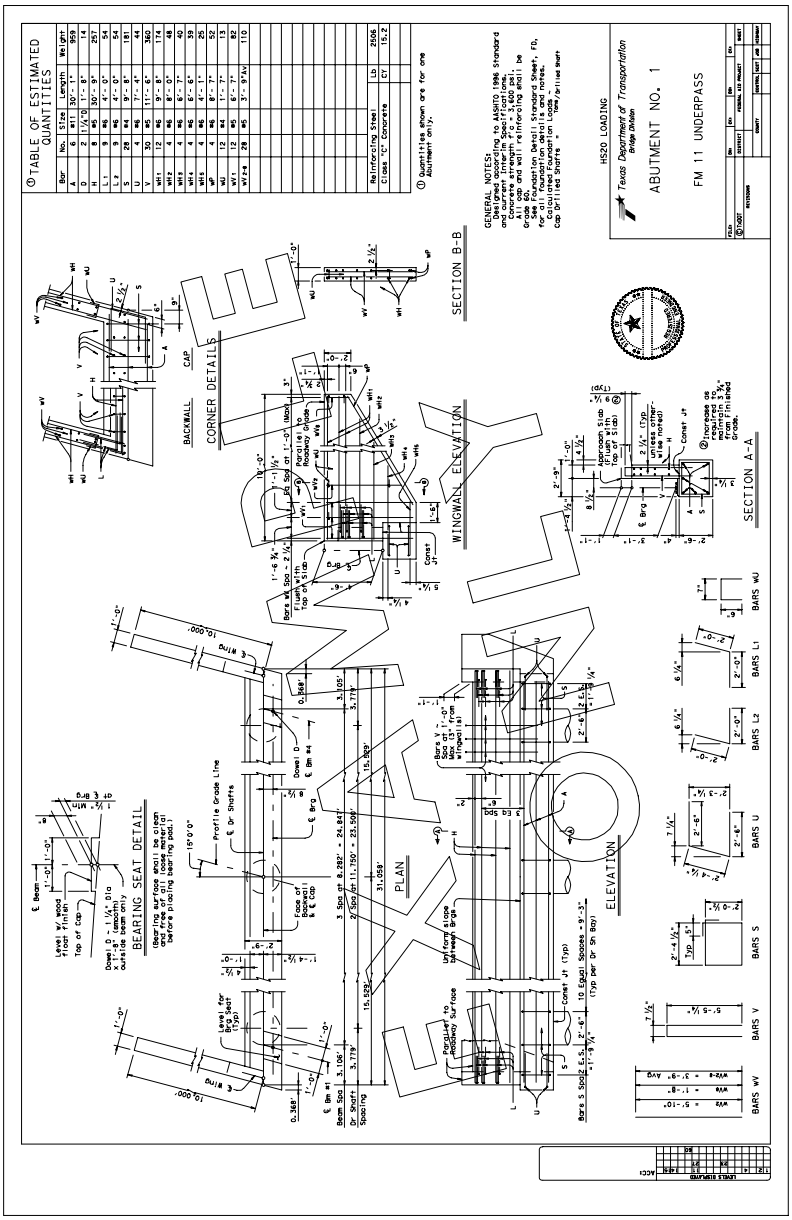


Figure 3-1: Abutment Sheet Example. Online users can click 3-1 to view this illustration in PDF.

Section 3
Sheet Checklist

Plan View

Accurate, measurable detail, with exceptions to enhance clarity

1. ☐ Locate the control line (matching the terminology on the layout, such as reference line, centerline, or profile grade line).

2. ☐ Control dimensions shall be referenced to a working point (usually the intersection of the control line and face of backwall).

3. ☐ Centerline of bearing located and dimensioned (normally 8 1/2", measured perpendicular to the face of the backwall)

4. ☐ Beam lines located and dimensioned along the face of backwall

5. ☐ Shaft or pile groups located and dimensioned along the centerline of foundations (normally at face of backwall at centerline of the cap). In addition to all other dimensions shown on the plan view, give a dimension from survey line (centerline, baseline, profile grade line, etc.) to the centerline of the nearest drilled shaft or pile group.

6. ☐ Overall length of cap dimensioned along the centerline of the cap, including cap offset dimensions for skewed structures (If over 15° skew, dimension to the point of cap breakback.)

7. ☐ Cap and backwall thickness dimensions

8. ☐ Working point dimensioned in relation to overall length of cap

9. ☐ Wingwalls dimensioned along the centerline of the cap of a founded wing or along the centerline of a cantilevered wing

10. ☐ Wingwall foundations, if applicable, located and dimensioned from the outside cap foundations

11. ☐ Typical bearing seat, dimensioned, labeled, and, if present, dowels D labeled and located (See Section 11 - Bearing Seat Details for information about when to use.)

12. ☐ Outside beam lines identified with beam number

13. ☐ Skew angles

14. ☐ Breakbacks, if present, dimensioned along the face of the backwall

Elevation View

Accurate, measurable detail, with exceptions to enhance clarity

1. ☐ Label slopes along top of backwall and cap (slopes need not be accurately shown unless the slope is abnormally large).
2. ☐ Foundations need not be detailed beyond location unless special foundation designs are used.
3. ☐ Stirrups detailed and dimensioned from foundations
4. ☐ Location of required construction joints (do not detail bar laps at joints unless staged construction is used). Construction joint required for over 80' (plus/minus), or as directed by the engineer, between outside cap piers.
5. ☐ Cap bars A detailed
6. ☐ Backwall bars H and V detailed and dimensioned
7. ☐ Bars L (and U, if present) positioned properly and in conformation with positioning in wingwall elevation view and in corner details
8. ☐ Approach slab or armor joint cutout detailed and dimensioned
9. ☐ Identify main section location.

Main Section ("Section A-A")

Accurate, measurable details, with exceptions to enhance clarity

1. ☐ Vertical cap and backwall section dimensioned at centerline of bearing
2. ☐ Vertical bearing buildup, bearing pad, and cap dimensions shown normal
3. ☐ Horizontal dimensions shown normal
4. ☐ Reinforcing cover
5. ☐ Locate construction joints

Wingwall Details ("Elevation" and "Section B-B")

Accurate, measurable details, with exceptions to enhance clarity

1. ☐ Vertical wall height above cap dimensioned at centerline of bearing
2. ☐ Horizontal wall dimensions shown normal
3. ☐ Critical reinforcing dimensions and covers shown
4. ☐ Bars L and U positioned in conformation with main elevation view and with corner details
5. ☐ Locate construction joints.
6. ☐ Identify wing section location

Corner Details ("Cap" and "Backwall" Plans)

Accurate, measurable details, with exceptions to enhance clarity

1. ☐ Skew properly shown
2. ☐ Reinforcing positioned in conformation with cap and backwall
3. ☐ Critical reinforcing dimensions and covers shown
4. ☐ Bars L and U positioned in conformation with main elevation view and with wingwall details

Other Details

Accurate, measurable details, with exceptions to enhance clarity

1. ☐ Bar details
2. ☐ Bearing seat detail
3. ☐ Joint details, if applicable
4. ☐ Table of estimated quantities
5. ☐ General notes (including, but not limited to, design criteria, loading, class of concrete, foundation loads, and cross references to various standard sheets)
6. ☐ Title block, information block, and engineer's seal

Final Checks

1. ☐ Check all details and dimensions against superstructure to ensure the details are not in conflict.

2. ☐ Double check bars in various details against the number of bars shown in estimated quantities table.

3. ☐ Ensure that the name of the bridge is the same on all detail sheets.

4. ☐ Initial the sheet after back-checking corrected details.

Section 4
Normal Parameters and Calculations

Cap and Backwall Parameters and Calculations

Normal abutment cap and backwall parameters are as follows:

- Maximum skew angle not requiring corner breakback is 15°.
- See Section 7 - Main Section Details for completed abutment sections.
- See Section 10 - Bar Details for all reinforcing bar locations and spacing.

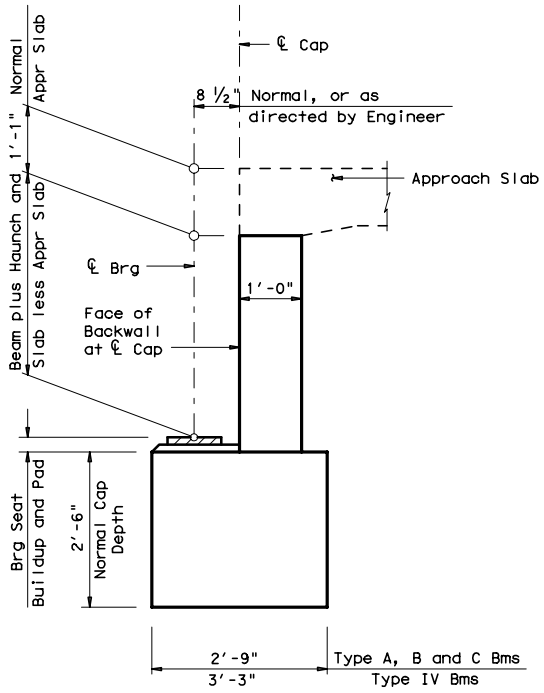
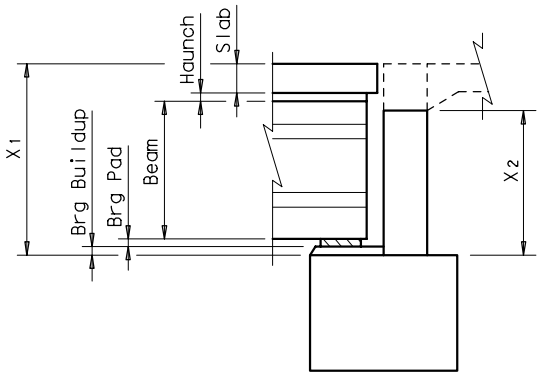
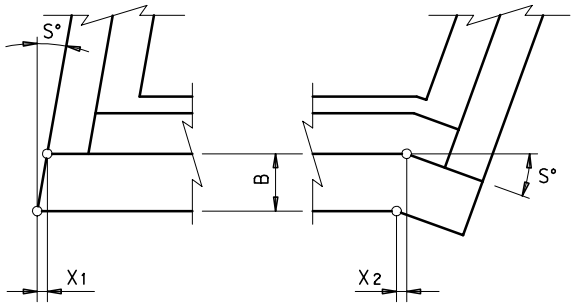


Figure 3-2: Cap and Backwall Parameters. Online users can click 3-2 to view this illustration in PDF.



X1 = Height of Backwall (with no approach slab)
= Slab + Haunch + Beam + Brg Pad + Brg Buildup
X2 = Height of Backwall (with approach slab)
= Deduct thickness of approach slab (1'-1" typical) from X1

Figure 3-3: Typical Section Showing Height of Backwall. Online users can click 3-3 to view this illustration in PDF.



X1 = (B) x (Tan Skew S°)
X2 = (B) x (Tan 0.5 Skew S°)

Skew S° = 0° Through 15° **Skew S° = Over 15°**

Figure 3-4: Typical Plan Views Showing Skew Offset Dimension Calculations. Online users can click 3-4 to view this illustration in PDF.

Wingwall Length Parameters and Calculations

Normal wingwall length parameters and calculations are as follows:

- Maximum length of a typical cantilevered wingwall is 12'.
- Minimum length of any wingwall is 4'.
- Use rectangular wingwall for concrete girder, box beam, and double - T abutments.

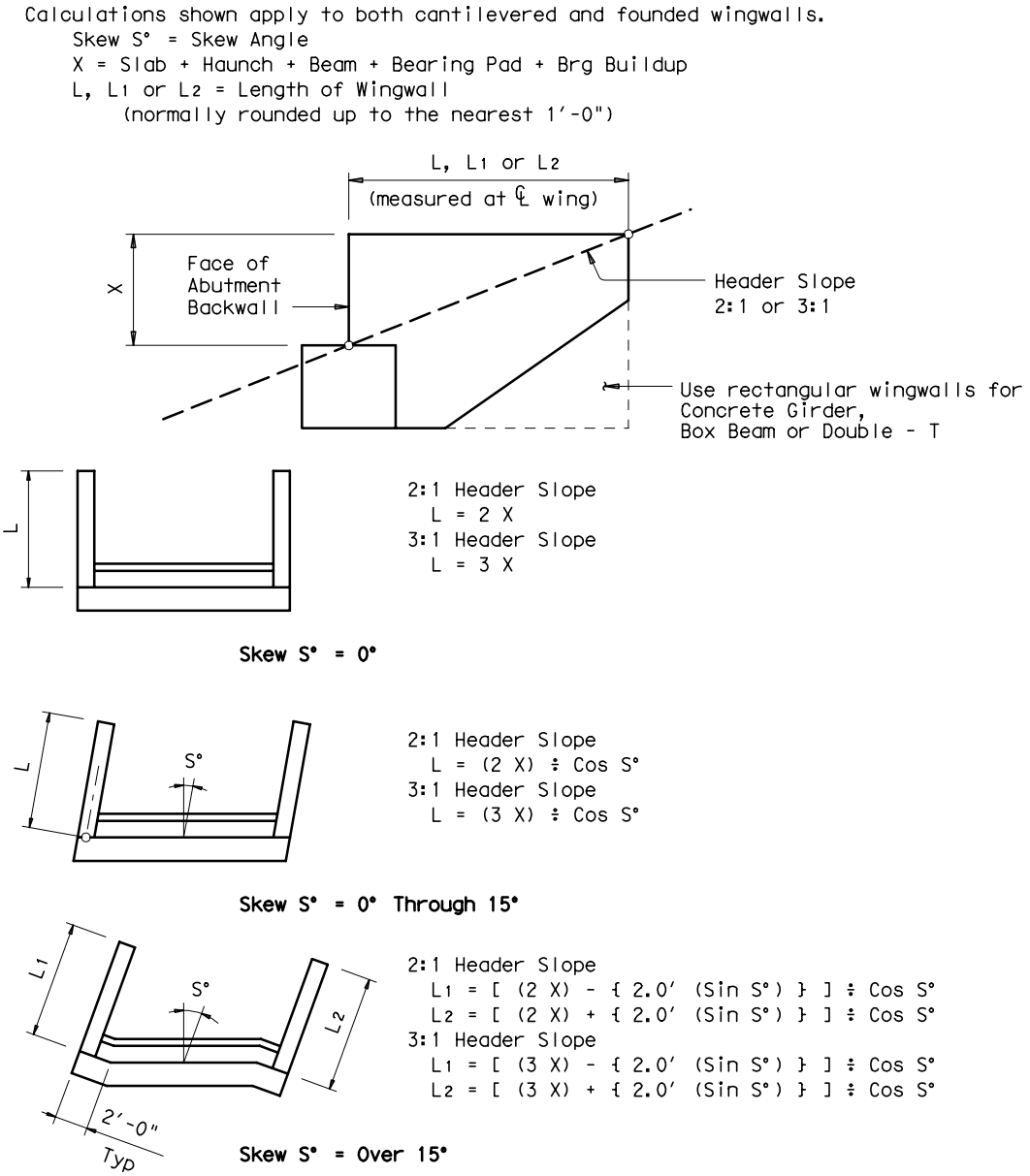


Figure 3-5: Wingwall Length Parameters and Calculations. Online users can click 3-5 to view this illustration in PDF.

Foundation Parameters and Calculations

Typical 0° skew abutment foundation parameters are as follows:

- 15'-0" - maximum spacing between main cap foundations, type A, B, and C beams*
- 13'-0" - maximum spacing between main cap foundations, type IV beams*
- 22'-0" - maximum length for a single foundation wingwall
- 16'-0" - maximum spacing between foundations on a multi-foundation wingwall
- Maximum end foundation spacing - See details below

*Round off spacing to nearest 3" where practical

NOTE: These are general guidelines used for developing standards. Unusual conditions may dictate that an engineering judgment be made.

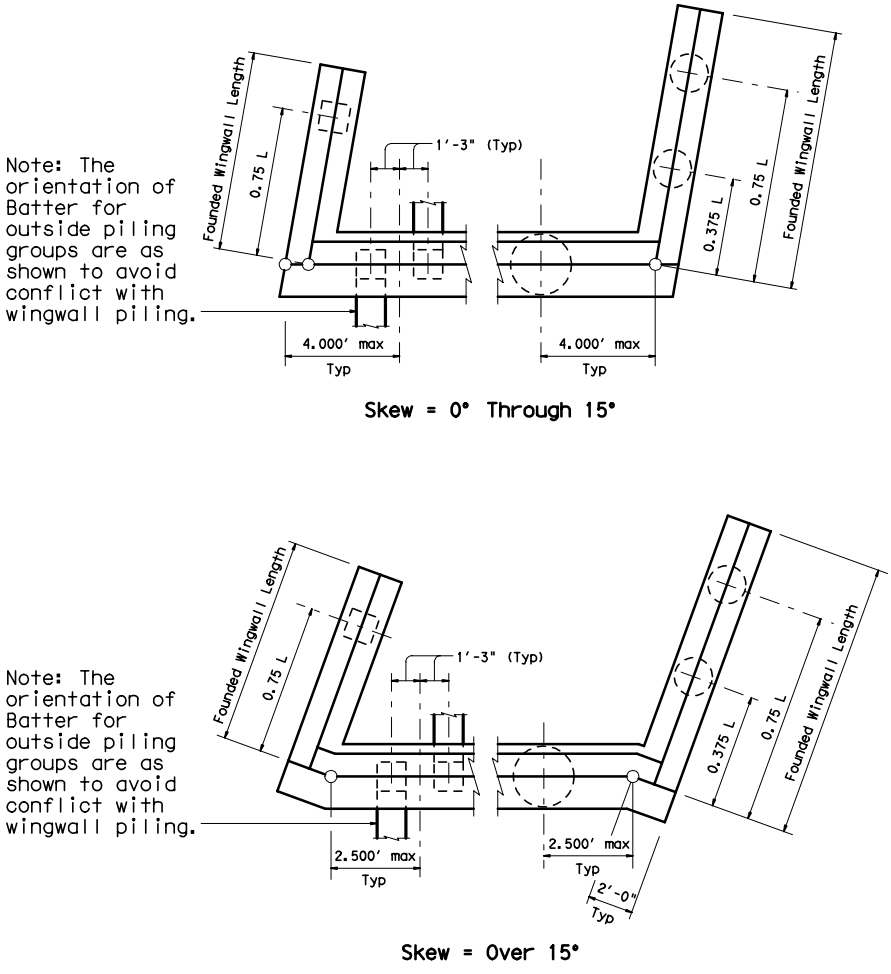
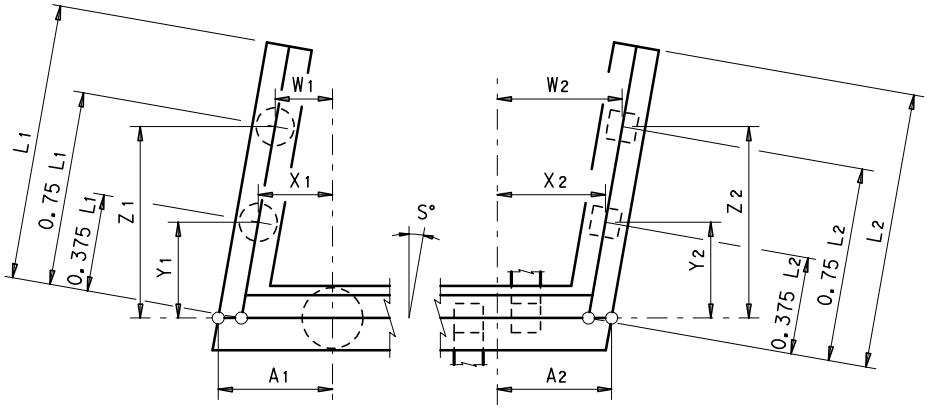
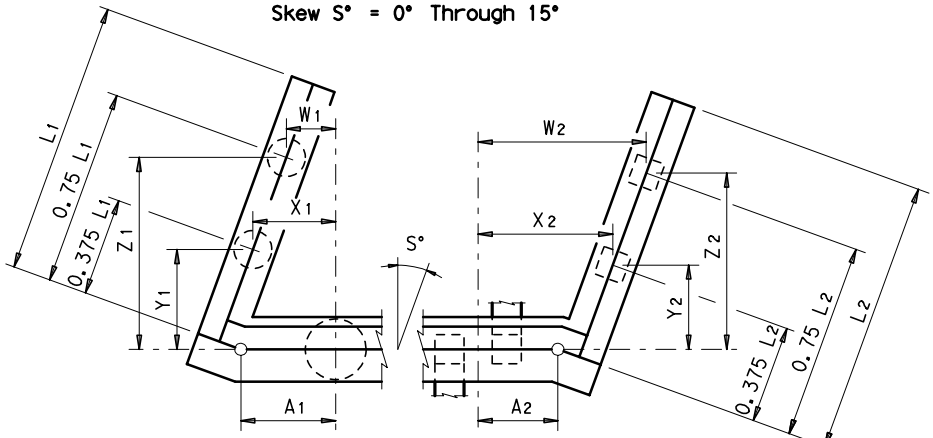


Figure 3-6: Foundation Parameters and Calculations. Online users can click 3-6 to view this illustration in PDF.



$W_1 = (A_1) - [1.0'/\cos S°] - [(\sin S°)(0.75)(L_1)]$
$W_2 = (A_2) - [1.0'/\cos S°] + [(\sin S°)(0.75)(L_2)]$
$X_1 = (A_1) - [1.0'/\cos S°] - [(\sin S°)(0.375)(L_1)]$
$X_2 = (A_2) - [1.0'/\cos S°] + [(\sin S°)(0.375)(L_2)]$
$Y_1 = (0.375)(L_1)(\cos S°)$
$Y_2 = (0.375)(L_2)(\cos S°)$
$Z_1 = (0.75)(L_1)(\cos S°)$
$Z_2 = (0.75)(L_2)(\cos S°)$

Skew S° = 0° Through 15°



$W_1 = (A_1) + [(\cos S°)(1.0')] - [(\sin S°)(0.75)(L_1)]$
$W_2 = (A_2) + [(\cos S°)(1.0')] + [(\sin S°)(0.75)(L_2)]$
$X_1 = (A_1) + [(\cos S°)(1.0')] - [(\sin S°)(0.375)(L_1)]$
$X_2 = (A_2) + [(\cos S°)(1.0')] + [(\sin S°)(0.375)(L_2)]$
$Y_1 = [(0.375)(L_1)(\cos S°)] + [(\sin S°)(1.0')]$
$Y_2 = [(0.375)(L_2)(\cos S°)] - [(\sin S°)(1.0')]$
$Z_1 = [(0.75)(L_1)(\cos S°)] + [(\sin S°)(1.0')]$
$Z_2 = [(0.75)(L_2)(\cos S°)] - [(\sin S°)(1.0')]$

Skew S° = Over 15°

Figure 3-7: Typical Plan Views with Calculations to Locate Foundations. Online users can click 3-7 to view this illustration in PDF.

Section 5
Plan View

Plan View Examples

The plan view checklist, presented in Section 3, should be followed to ensure that details are accurate and complete. Excepting dowels D, reinforcing will not normally be shown on the plan view.

NOTE: All dimensions are for example only.

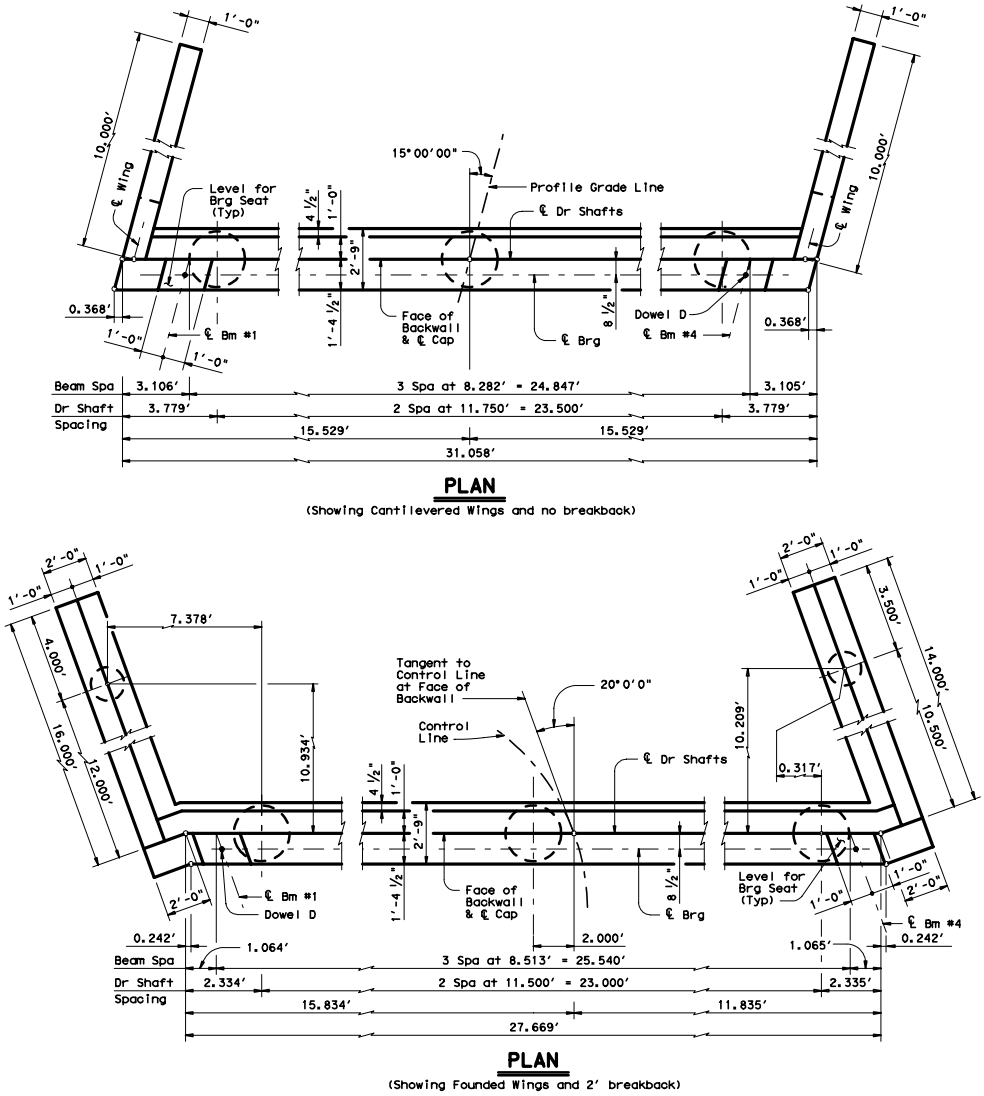


Figure 3-8: Plan View Examples. Online users can click 3-8 to view this illustration in PDF.

(1)	Control line (Station Line or PGL)	(8)	Thickness dimensioning
(2)	Working point	(9)	Wingwall dimensioning
(3)	Centerline of bearing	(10)	Wingwall foundation dimensioning
(4)	Beam spacing dimensioning	(11)	Bearing seat information
(5)	Foundations dimensioning	(12)	Beam lines identified
(6)	Overall and offset dimensioning	(13)	Skew information
(7)	Working point dimensioning	(14)	Breakback dimensioning

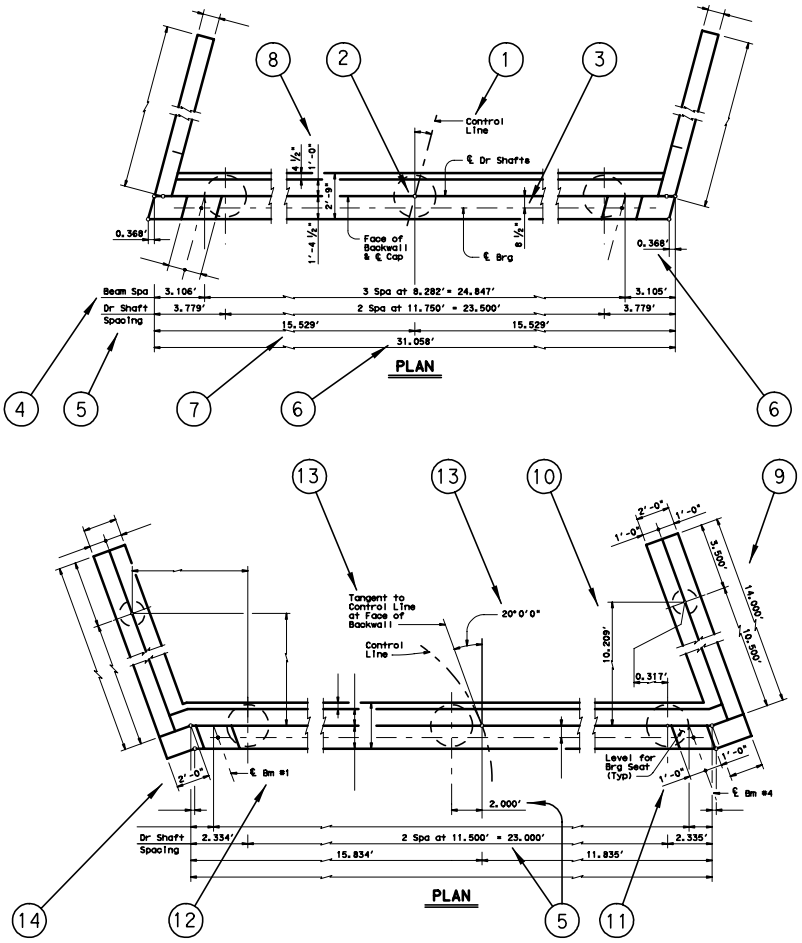


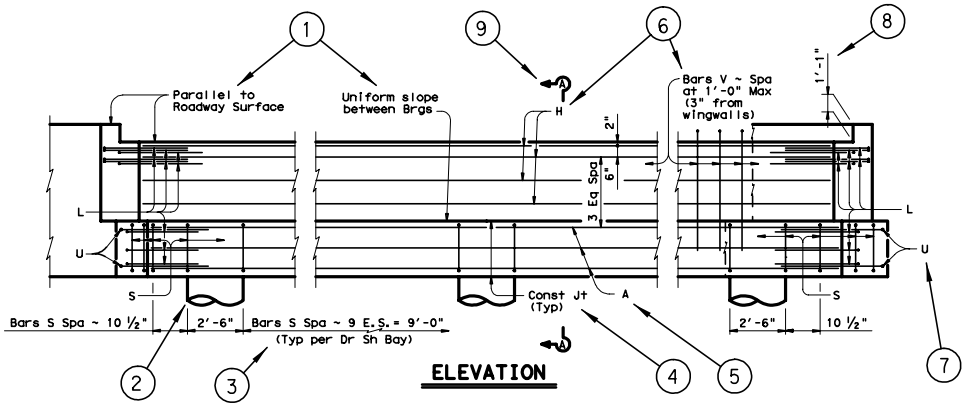
Figure 3-9: Plan View, Checklist Item. Online users can click 3-9 to view this illustration in PDF.

Section 6
Elevation View

Elevation View Example

The elevation view checklist, presented in Section 3, should be followed to ensure that the details are accurate and complete. Cap and backwall reinforcing shall normally be shown on the elevation view. Wingwall reinforcing and bearing seat dowels D will not normally be shown.

NOTE: Bars S spacing shown is for example only. Bars H spacing is shown for the most common "C Beam Abutment." For type A or B beams use 2 equal spaces and 4 equal spaces for type IV beams.



1. Slope Information
2. Foundations
3. Stirrups dimensioned
4. Construction joints
5. Cap bars A
6. Backwall bars H and V
7. Bars L and U
8. Approach slab dimensioned
9. Section identification

Figure 3-10: Elevation View Example. Online users can click 3-10 to view this illustration in PDF.

Section 7
Main Section Details

Main Section Examples

The main section checklist, presented in Section 3, should be followed to ensure that the details are accurate and complete. (Note that labeling, dimensioning, reinforcing locations, and reinforcing spacings shown below are for example only.) Reinforcing shall normally be shown in the section view. See Section 10 - Bar Details for reinforcing bar locations and spacing.

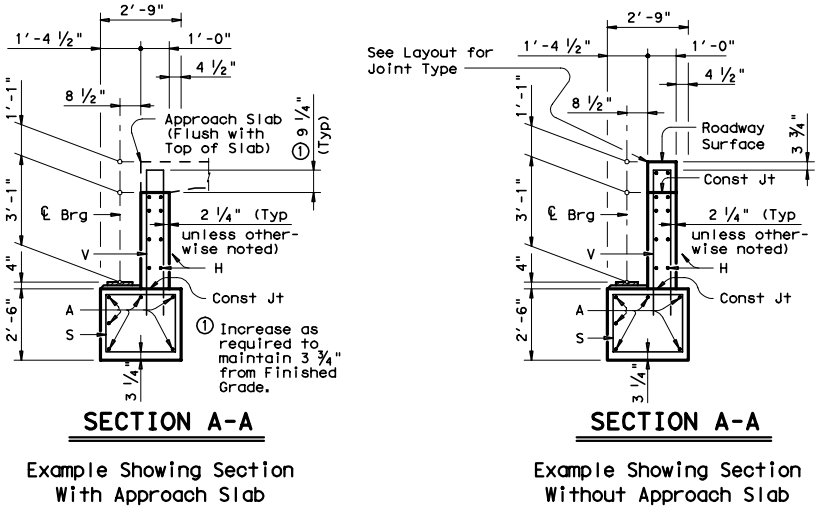


Figure 3-11: Main Section Examples. Online users can click 3-11 to view this illustration in PDF.

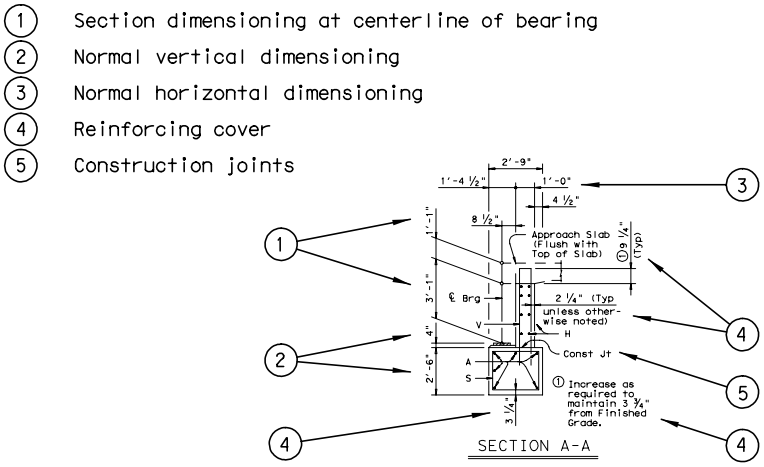


Figure 3-12: Main Section, Checklist Items. Online users can click 3-12 to view this illustration in PDF.

Section 8
Wingwall Details

Wingwall Details Examples

The wingwall details checklist, presented in Section 3, should be followed to ensure that the details are accurate and complete. Note that wH bar spacing matches H bar spacing in the backwall. Examples shown below are for type C beam abutments.

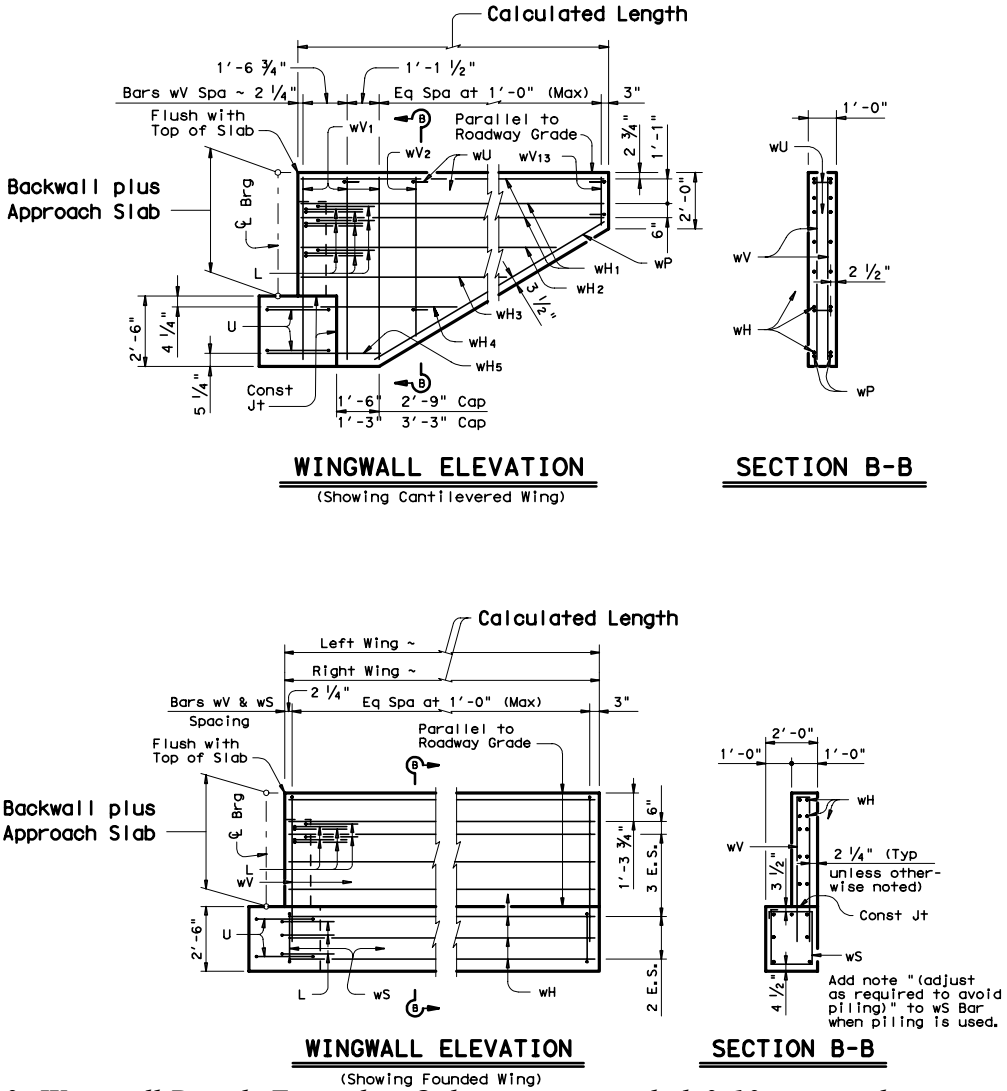


Figure 3-13: Wingwall Details Examples. Online users can click 3-13 to view this illustration in PDF.

1. Section dimensioning at centerline of bearing
2. Normal horizontal dimensioning
3. Critical reinforcing dimensions and cover
4. Bars L and U
5. Construction joints
6. Wing section location

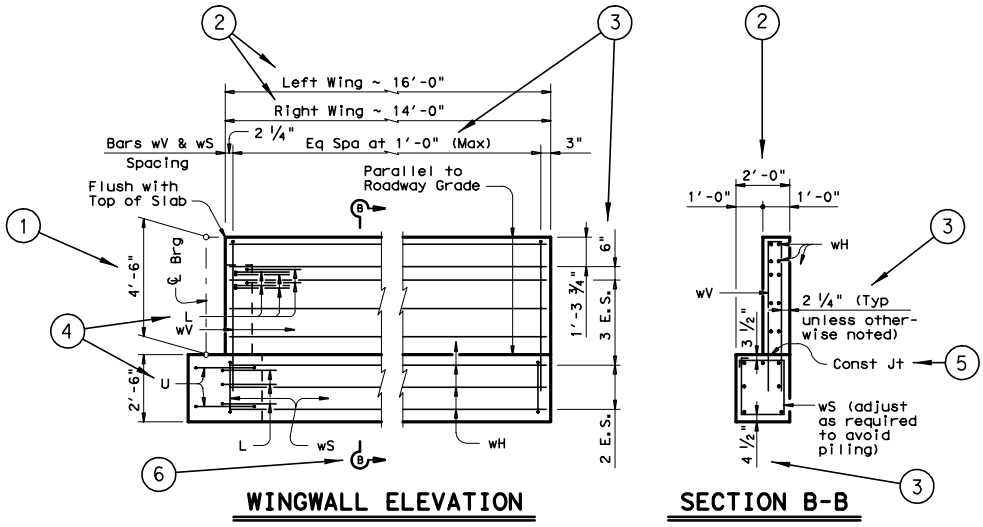


Figure 3-14: Elevation View, Checklist Items. Online users can click 3-14 to view this illustration in PDF.

Section 9
Corner Details

Corner Details Examples

The corner details checklist, presented in Section 3, should be followed to ensure that the details are accurate and complete. Note that the corner details should include plan section views of both the cap and the backwall and that reinforcing shall normally be shown. Foundations are normally not shown.

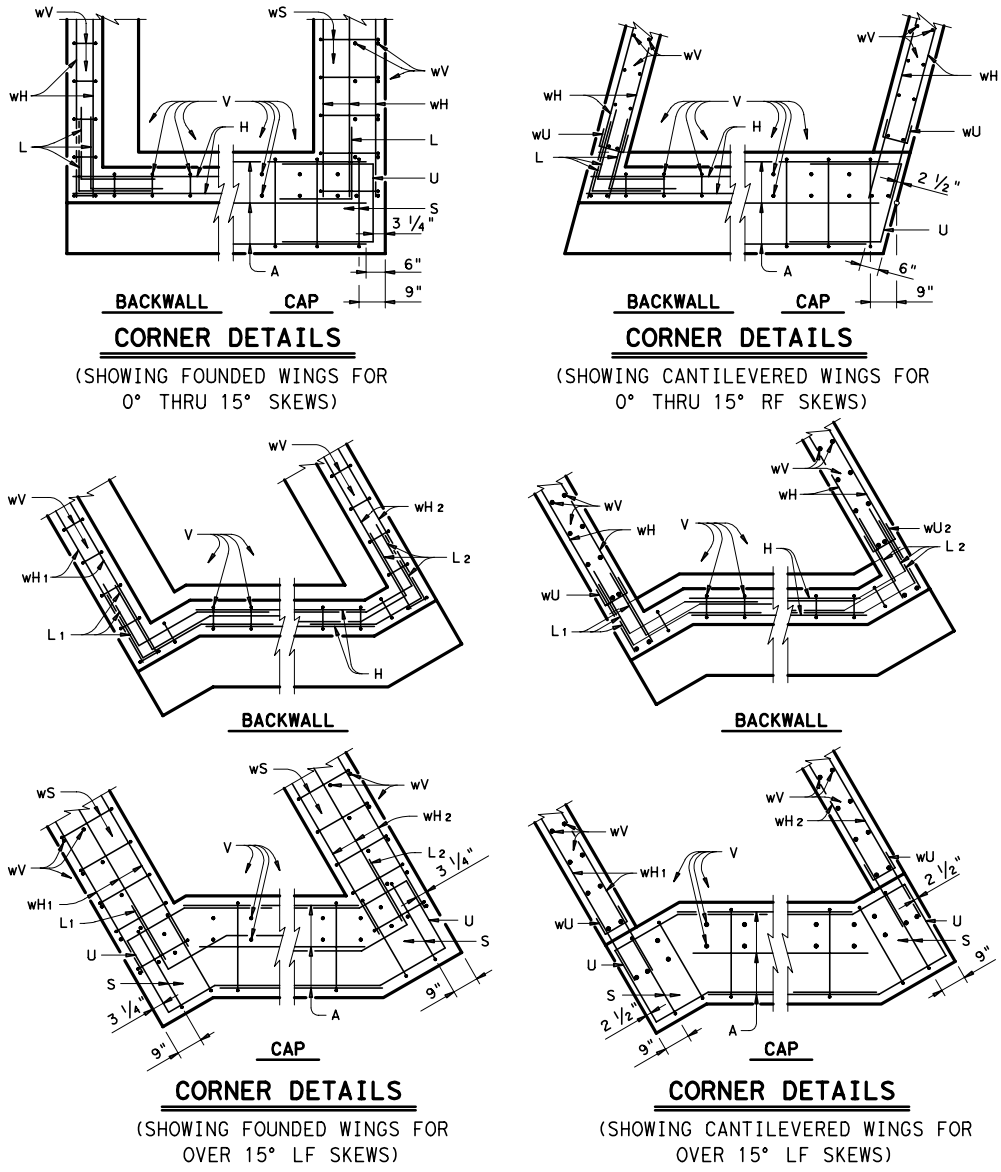


Figure 3-15: Corner Details Examples. Online users can click 3-15 to view this illustration in PDF.

(1) Skew accurately shown
(2) Reinforcing accurately shown
(3) Critical dimensions and cover
(4) Special corner reinforcing

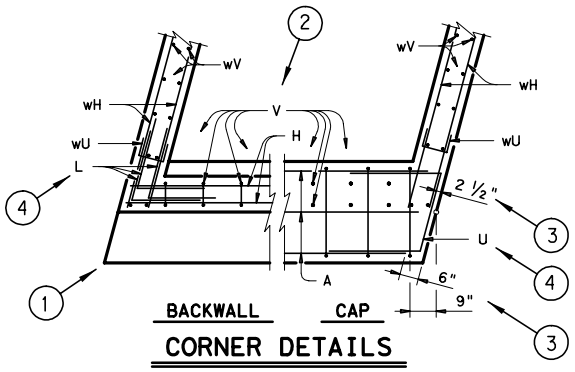


Figure 3-16: Corner Details, Checklist Items. Online users can click 3-16 to view this illustration in PDF.

Section 10
Bar Details

Typical Bar Sizes for Abutments

The information in this section shows typical abutment reinforcing and its placement. The rebar weights, bends, and locations may be different from those given due to structural design requirements.

Abutment reinforcing default sizes are as follows:

Table 3-2: Typical Bar Sizes

Bars	Typical Size
Bars A	#11
Bars D	1 1/4" diameter (1'-8" normal length)
Bars H	#5
Bars L	#6
Bars S	#4
Bars U	#6
Bars V	#5
Bars wH	#6
Bars wP	#6
Bars wS	#4
Bars wU	#4
Bars wV	#5

Details need not be shown for straight bars unless the bars are lap spliced and the location of the lap is significant.

The maximum length of a rebar, without the requirement for a bar lap, is 60 feet.

Bars A Details

"Bars A" is the normal designation for the main cap reinforcing. Bars A fit within the cap stirrups (bars S) and shall end as shown below. If a splice is required, the lap shall be placed at a convenient quarter point between foundations and dimensioned adequately. The lap required for reinforcing placed in the top of the cap shall be used for all bars A splices.

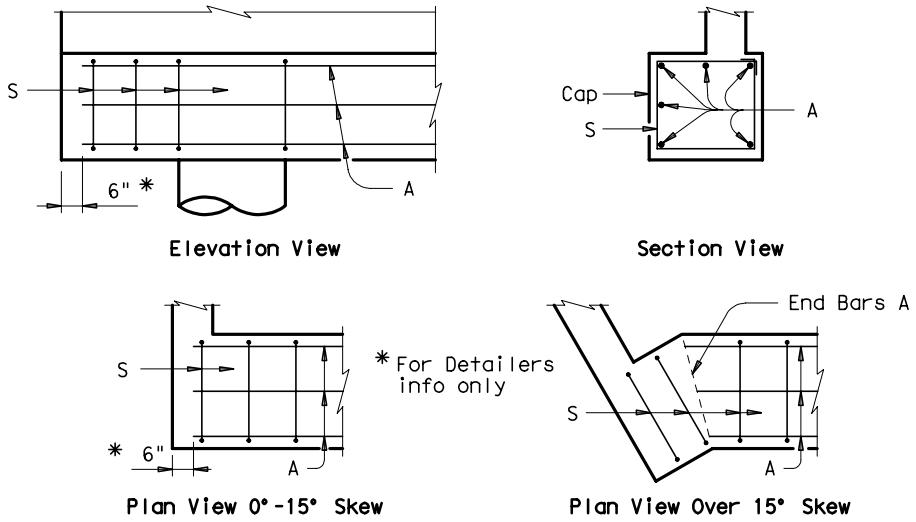


Figure 3-17: Bars A Details. Online users can click 3-17 to view this illustration in PDF.

Bars H Details

"Bars H" is the normal designation for the horizontal backwall reinforcing. Bars H fit within the backwall vertical reinforcing (bars V) as shown below. If a splice is required, the lap may be placed at any convenient location. It will not be necessary to detail the lap for bars H. The equal spaces between the H bars detailed 8" from the top of backwall and the top A bar shall not exceed 1'-6".

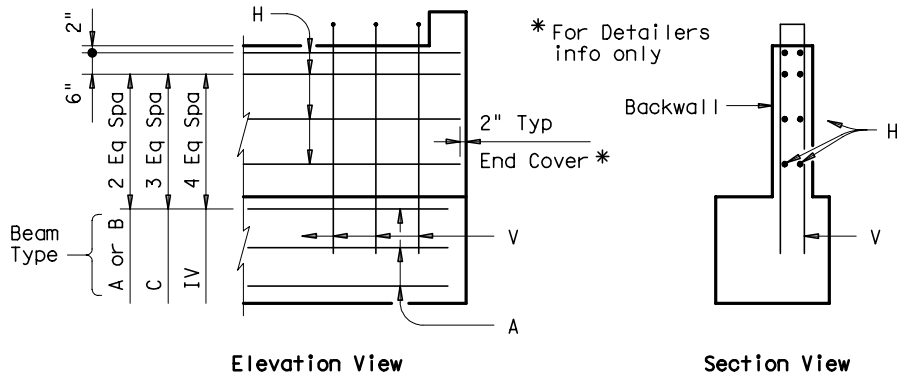
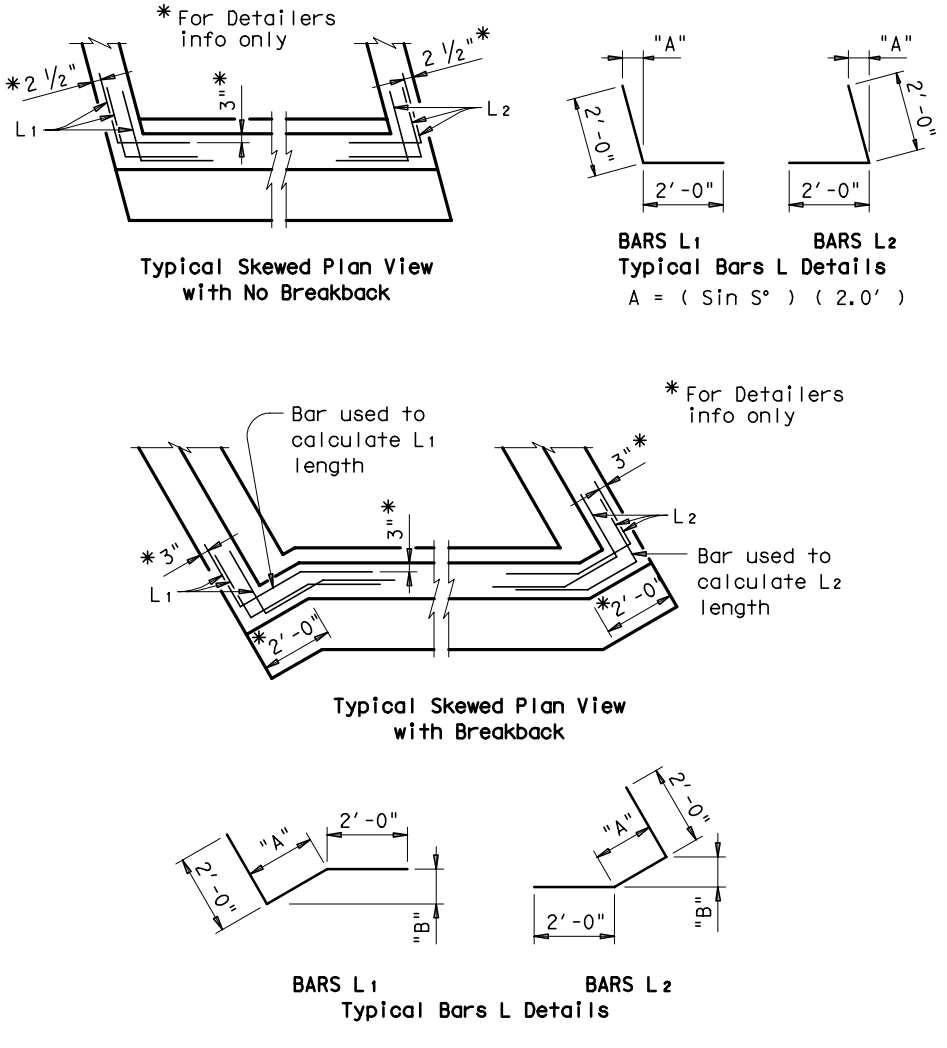


Figure 3-18: Bars H Details. Online users can click 3-18 to view this illustration in PDF.

Bars L Details

"Bars L" is the normal designation for the main corner reinforcing. Note that although only the backwall section is shown below, bars L are also required in the cap when founded wingwalls are used. In this condition, the cap bars L shall be identical to those used in the backwall.



Bars L1

A=1.75'+[(Tan 0.5 S°)(0.75')]
B=(Sin S°)(A)

Bars L2

A=1.75'-[(Tan 0.5 S°)(0.25')]
B=(Sin S°)(A)

Figure 3-19: Bars L Details. Online users can click 3-19 to view this illustration in PDF.

Bars S Details

"Bars S" is the normal designation for the main cap stirrup reinforcing. Bars S fit around the foundations as shown below.

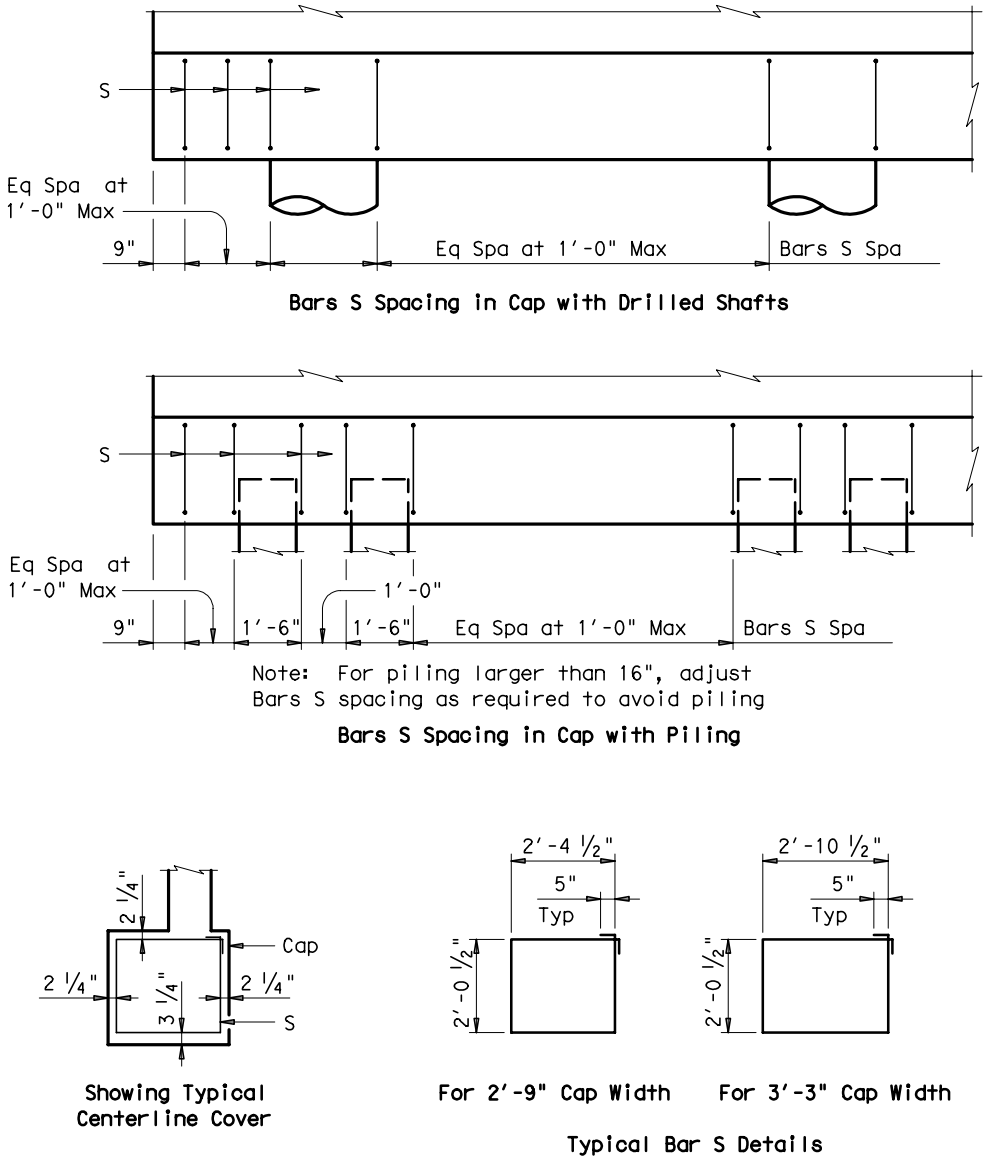
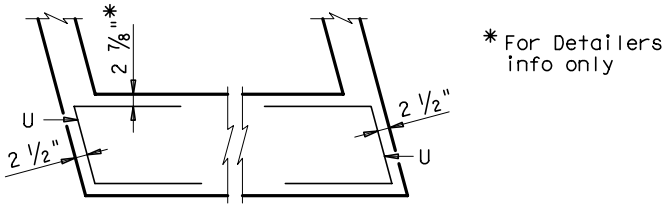


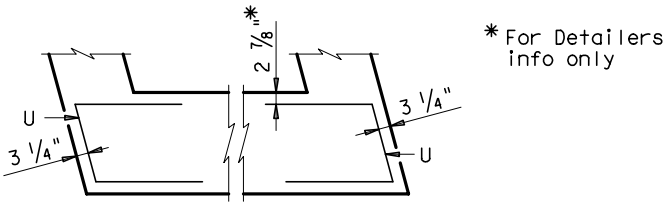
Figure 3-20: Bars S Details. Online users can click 3-20 to view this illustration in PDF.

Bars U Details without Breakback

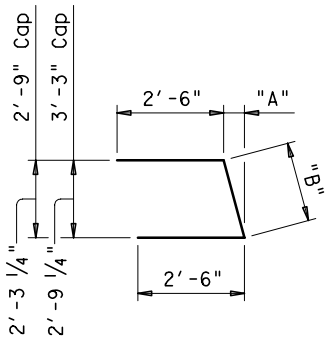
"Bars U" is the normal designation for the main cap end reinforcing. Bars U fit within the cap stirrups (bars S).



Typical Skewed Plan View
with Cantilevered Wings and No Breakback



Typical Skewed Plan View
with Founded Wings and No Breakback

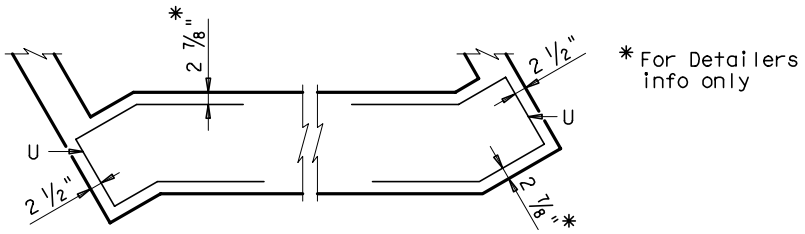


Typical Bar U Detail

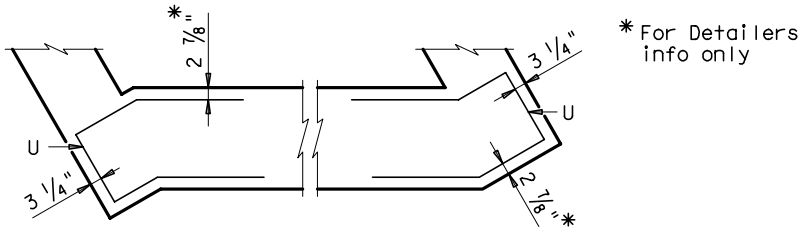
2'-9" Cap Width	3'-3" Cap Width
A=(Tan S°)(2.2708')	A=(Tan S°)(2.7708')
B=(2.2708') ÷ (Cos S°)	B=(2.7708') ÷ (Cos S°)

Figure 3-21: Bars U Details without Breakback. Online users can click 3-21 to view this illustration in PDF.

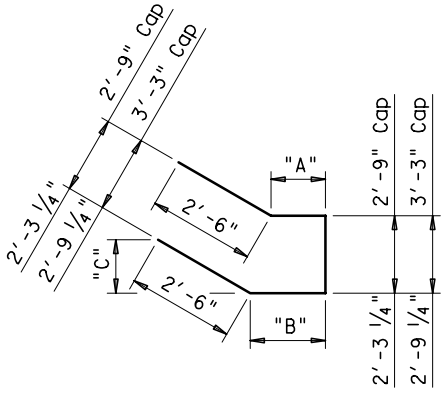
Bars U Details with Breakback



Typical Skewed Plan View
with Breakback and Cantilevered Wings



Typical Skewed Plan View
with Breakback and Founded Wings



Typical Bar U Detail

Cantilevered Wing and 2'-9" Cap

A=1.7917'-[(Tan 0.5 S°)(1.1354')]
B=1.7917'+[(Tan 0.5 S°)(1.1354')]
C=(Sin S°)(2.5')

Founded Wing and 2'-9" Cap

A=1.7292'-[(Tan 0.5 S°)(1.1354')]
B=1.7292'+[(Tan 0.5 S°)(1.1354')]
C=(Sin S°)(2.5')

Cantilevered Wing and 3'-3" Cap

A=1.7917'-[(Tan 0.5 S°)(1.3854')]
B=1.7917'+[(Tan 0.5 S°)(1.3854')]
C=(Sin S°)(2.5')

Founded Wing and 3'-3" Cap

A=1.7292'-[(Tan 0.5 S°)(1.3854')]
B=1.7292'+[(Tan 0.5 S°)(1.3854')]
C=(Sin S°)(2.5')

Figure 3-22: Bars U Details with Breakback. Online users can click 3-22 to view this illustration in PDF.

Bars V Details

"Bars V" is the normal designation for the vertical backwall reinforcing. Bars V fit around the backwall horizontal reinforcing (bars H).

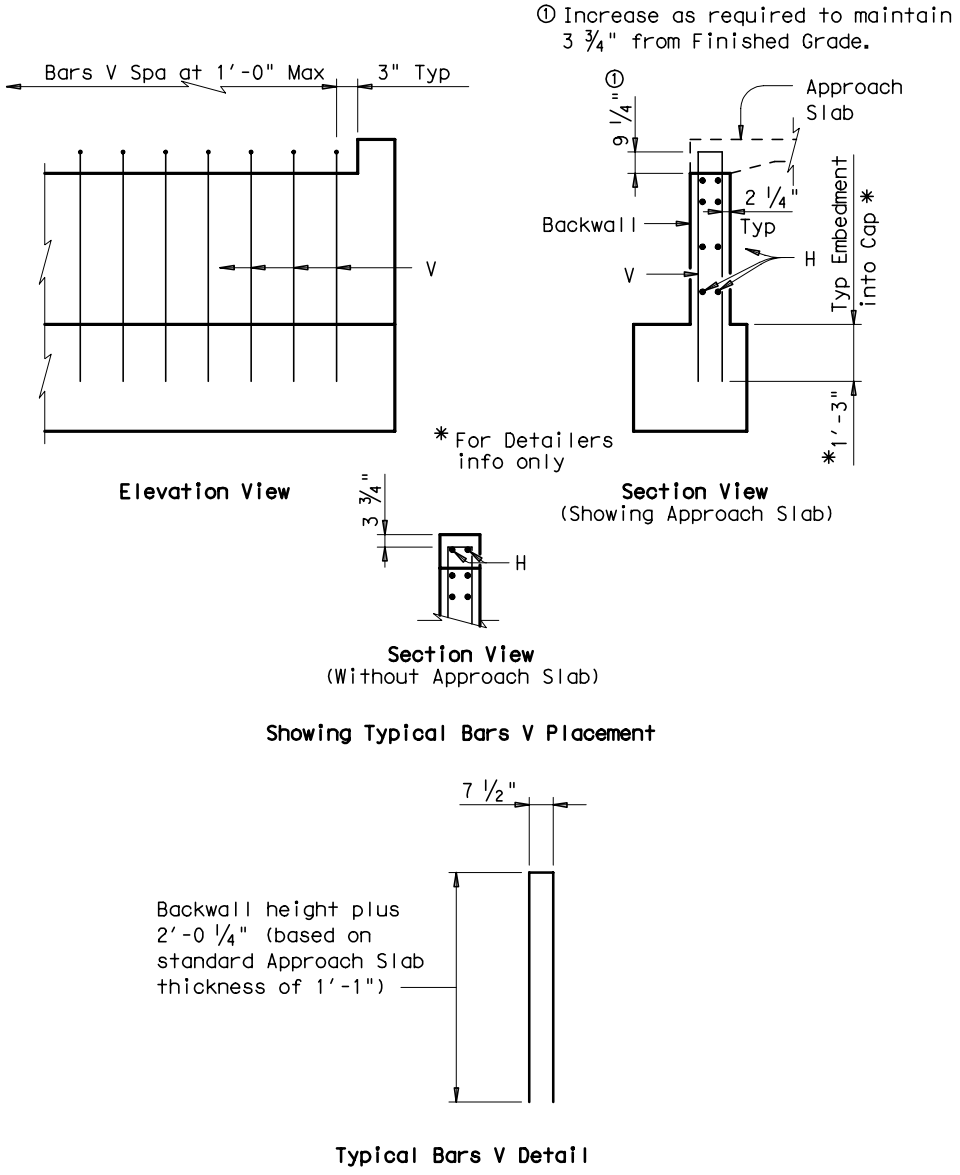


Figure 3-23: Bars V Details. Online users can click 3-23 to view this illustration in PDF.

Bars wH Details

"Bars wH" is the normal designation for the horizontal wingwall reinforcing. In cantilevered wings, bars wH are placed outside the wingwall vertical reinforcing (bars wV), while in founded wings, bars wH are placed to the inside of the vertical reinforcing (bars wV) and to the inside of the wing cap stirrups (bars wS). Bars wH will normally rest on or under bars H and A, in the abutment backwall and cap, so that bar wH spacing is established by their positions.

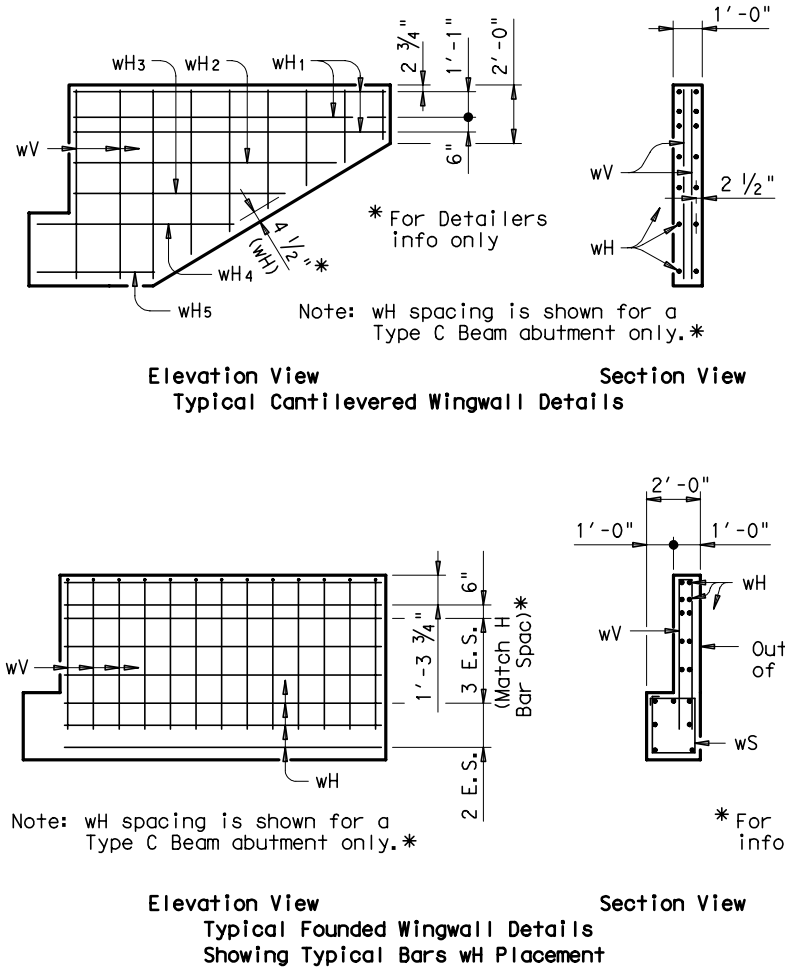


Figure 3-24: Bars wH Details. Online users can click 3-24 to view this illustration in PDF.

Bars wP Details

"Bars wP" is the normal designation for the cantilevered wingwall sloped bottom reinforcing. Bars wP fit outside the vertical wingwall reinforcing (bars wV) as shown below.

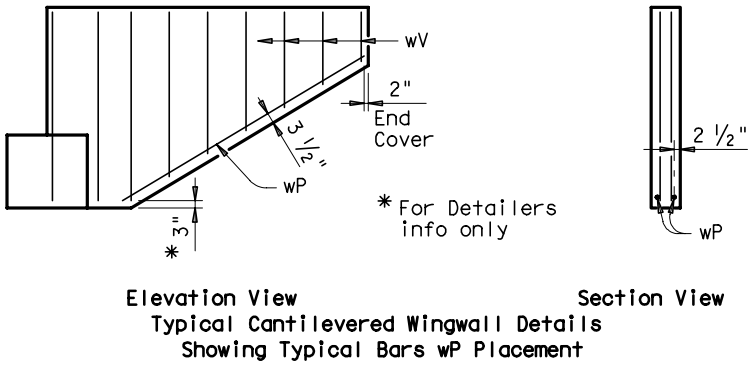


Figure 3-25: Bars wP Details. Online users can click 3-25 to view this illustration in PDF.

Bars wS Details

"Bars wS" is the normal designation for the founded wingwall cap stirrups. If required, adjust bars wS spacing as required to clear embedded piling.

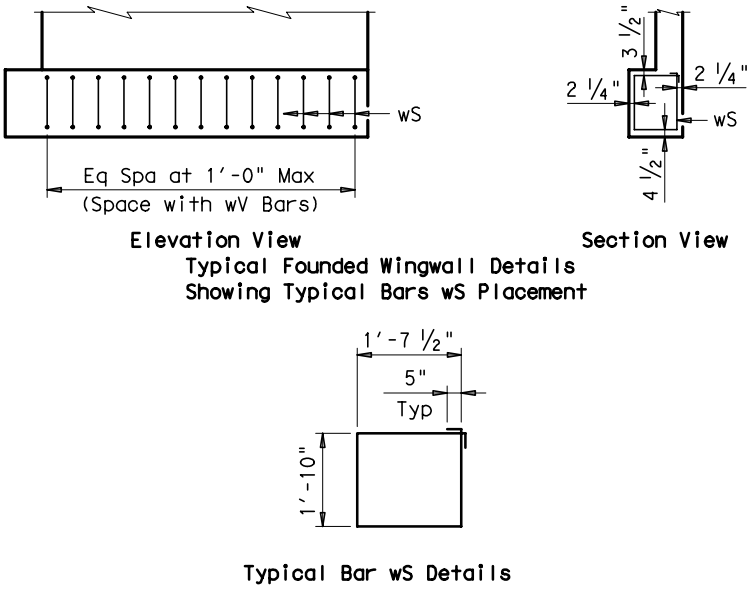
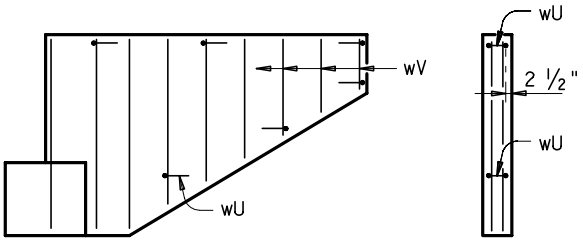


Figure 3-26: Bars wS Details. Online users can click 3-26 to view this illustration in PDF.

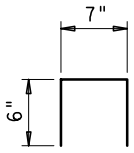
Bars wU Details

"Bars wU" is the normal designation for the tie bars that hold cantilevered wingwall reinforcing mats in position. Bars wU fit outside the vertical wingwall reinforcing (bars wV) as shown below.

Wing Length	Number of wU Bars per Wing
6′ & 7′	4
8′ thru 11′	6
12′	8



Elevation View Section View
Typical Cantilevered Wingwall Details
Showing Typical Bars wU Placement



Typical
Bar wU
Details

Figure 3-27: Bars wU Details. Online users can click 3-27 to view this illustration in PDF.

Bars wV Details

"Bars wV" is the normal designation for the vertical wingwall reinforcing. In cantilevered wings, bars wV are placed inside of the wingwall horizontal reinforcing (bars wH), while in founded wings, bars wV are placed outside the horizontal reinforcing (bars wH).

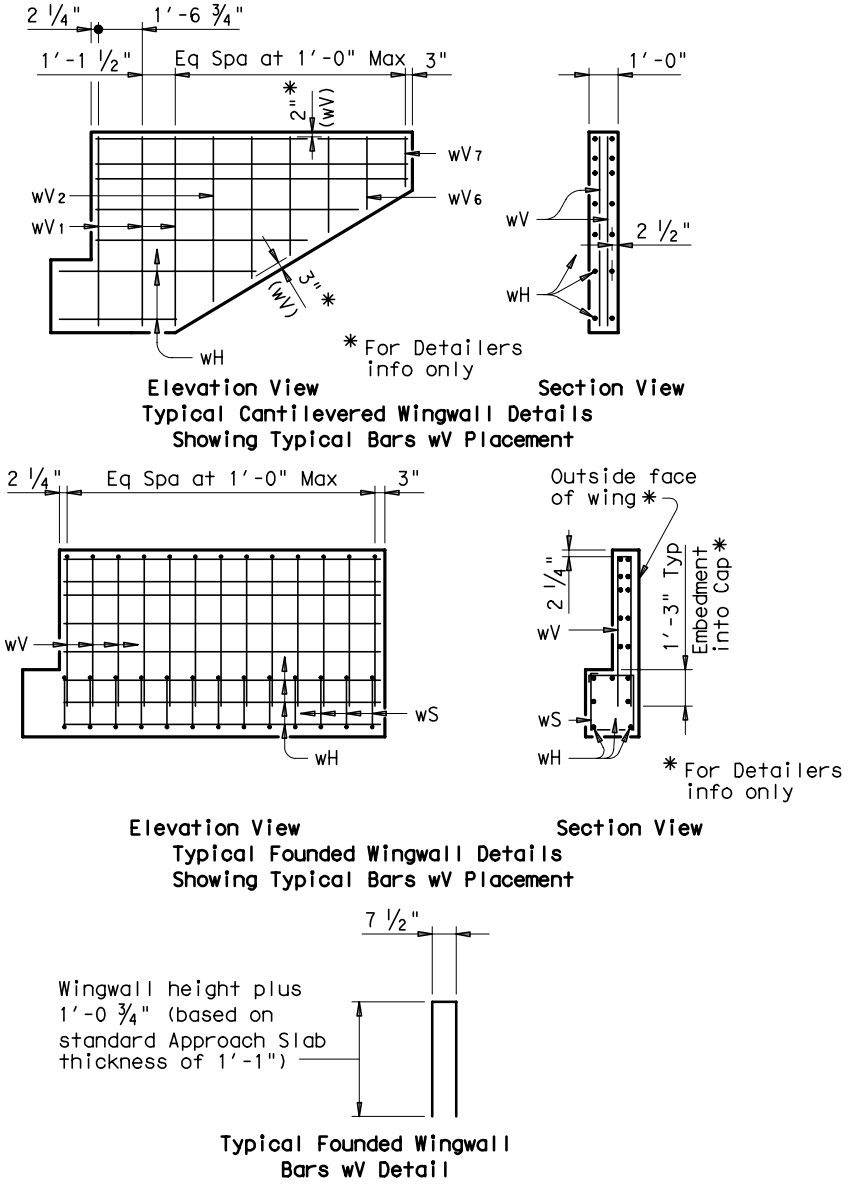


Figure 3-28: Bars wV Details. Online users can click 3-28 to view this illustration in PDF.

Section 11
Miscellaneous Details

Bearing Seat Details

Bearing seats shall normally be shown on the plan view as detailed below. The centerline of bearing shall be measured perpendicular to the face of the backwall. The buildup shall follow the skew of the beam. Buildup dimensions need be shown only once in this view. A typical bearing seat detail, as shown below, shall be included on the Abutment Sheet. Note that details shown are for a standard size cap. Larger caps or unusual details may require special details.

Dowels D shall normally be placed at outside beams only, although staged construction may require additional dowels, and wide structures may require dowels to be moved to inside beams. Dowels D will be used at the ends of simple spans but shall not be used at the ends of multiple span units. Refer to the Bridge Design Manual for additional information.

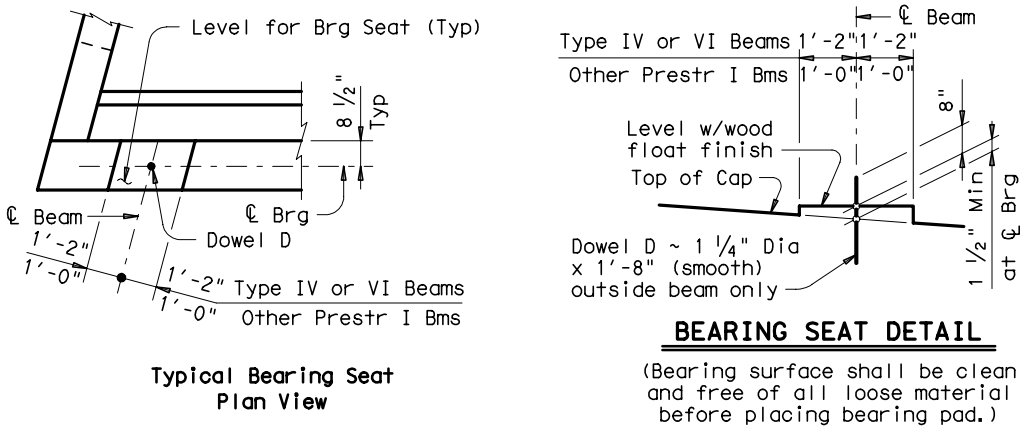
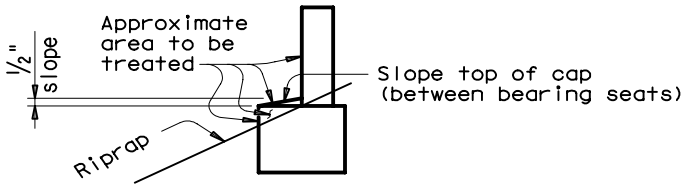


Figure 3-29: Bearing Seat Details. Online users can click 3-29 to view this illustration in PDF.

Waterproofing Details

A waterproofing detail shall be included on the Abutment Detail Sheet only when directed by the engineer. If included, the detail shall be similar to that shown below.



WATERPROOFING DETAIL

(The face of backwall, top, front, and ends of the cap as shown, except bearing seats, shall be treated with a Silane based sealer, per Special Specification "Penetrating Concrete Surface Treatment".)

Figure 3-30: Typical Waterproofing Detail. Online users can click 3-30 to view this illustration in PDF.

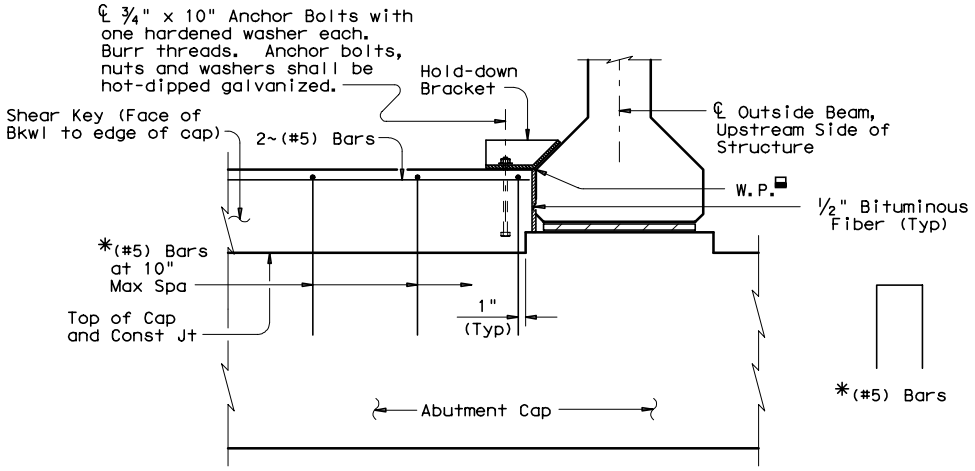
Beam Hold-Down Detail

Include the following note on plans:

"Beam hold-downs and shear keys shall be placed between the outside beam and first interior beam, upstream side of the structure at all abutments."

The cost for furnishing and installing hold-down brackets shall be considered subsidiary to class "C" concrete.

Place Note on Plans: Beam Hold-Downs and Shear Keys shall be placed between the Outside Beam and first Interior Beam, Upstream Side of the Structure at all Abutments.
The cost for furnishing and installing hold-down brackets shall be considered subsidiary to Class "C" Concrete.



PARTIAL ELEVATION

Pour Shear Key flush to Working Point (W.P.). ½" bituminous fiber shall be installed at the interface of the beam and shear key. Shear Key concrete to be poured after beams are placed. Care shall be taken to keep concrete from flowing under the beams.

Figure 3-31: Beam Hold-Down Detail. Online users can click 3-31 to view this illustration in PDF.

Beam Hold-Down Bracket

NOTE: Hold-down brackets shall be hot-dipped galvanized after fabrication.

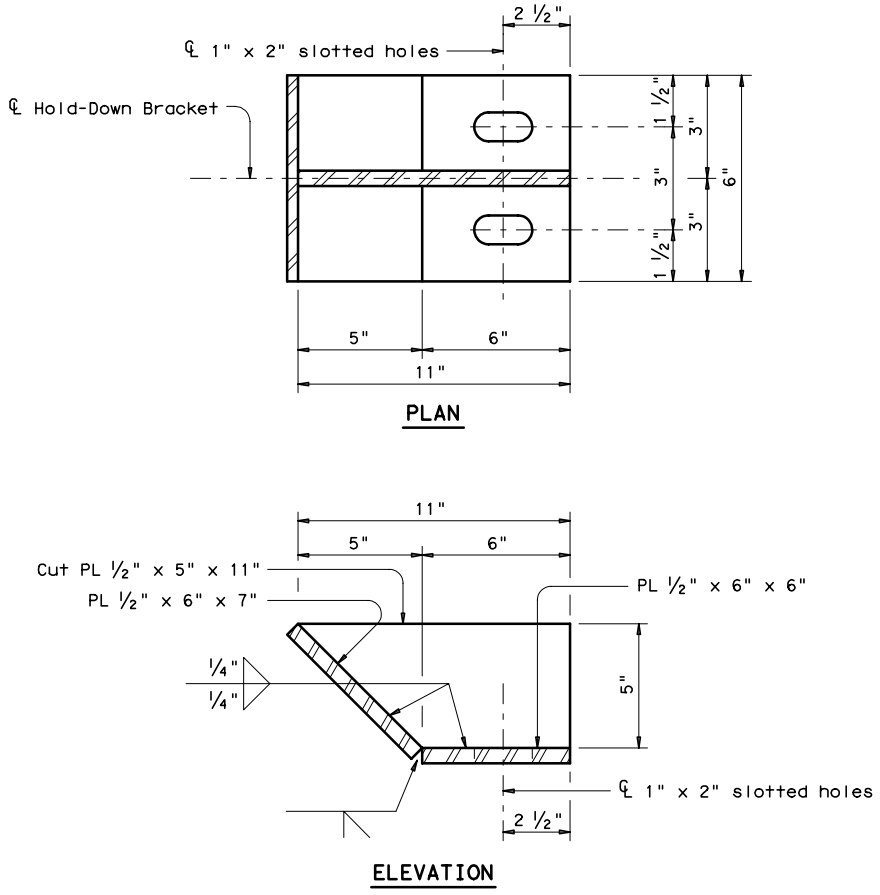


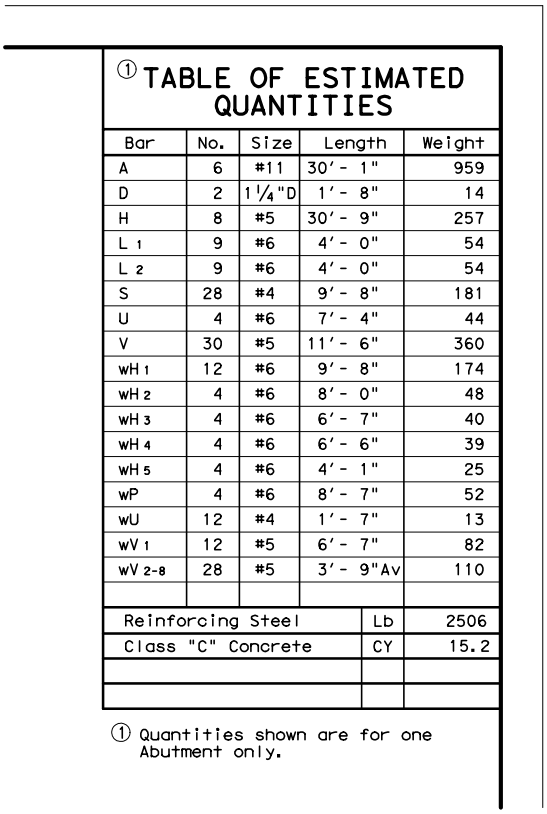
Figure 3-32: Beam Hold-Down Bracket. Online users can click 3-32 to view this illustration in PDF.

Typical Table of Estimated Quantities

A Table of Estimated Quantities shall normally be shown on the plan view as detailed below. If the detail sheet is for both the beginning and end of bridge abutments, a numbered note, as shown below, shall be included with the table.

Quantities shall be shown in the table as listed below:

- Bar lengths - in feet and inches to the nearest even inch
- Bar weights - in pounds to the nearest pound
- Concrete volume - in cubic yards to the nearest 0.1 cubic yard



① TABLE OF ESTIMATED QUANTITIES

Bar	No.	Size	Length	Weight
A	6	#11	30′ - 1"	959
D	2	1¼"D	1′ - 8"	14
H	8	#5	30′ - 9"	257
L 1	9	#6	4′ - 0"	54
L 2	9	#6	4′ - 0"	54
S	28	#4	9′ - 8"	181
U	4	#6	7′ - 4"	44
V	30	#5	11′ - 6"	360
wH 1	12	#6	9′ - 8"	174
wH 2	4	#6	8′ - 0"	48
wH 3	4	#6	6′ - 7"	40
wH 4	4	#6	6′ - 6"	39
wH 5	4	#6	4′ - 1"	25
wP	4	#6	8′ - 7"	52
wU	12	#4	1′ - 7"	13
wV 1	12	#5	6′ - 7"	82
wV 2-8	28	#5	3′ - 9"Av	110
Reinforcing Steel			Lb	2506
Class "C" Concrete			CY	15.2

① Quantities shown are for one Abutment only.

Figure 3-33: Typical Table of Estimated Quantities. Online users can click 3-33 to view this illustration in PDF.

General Notes, Title Block, and P.E. Seal

The general notes, title block, and engineer's seal shall normally be shown on the detail sheet in the format given below. Note that there will be considerable variation in the general notes between jobs, depending on structural needs. Particular care shall be taken to ensure that the loading criteria given are correct. If armor joint is used at the abutment, add to the general notes:

"See Armor Joint Standard Sheet, AJ, for details."

Whenever possible, space should be made available on the sheet to the immediate left of the title block for the engineer's seal.

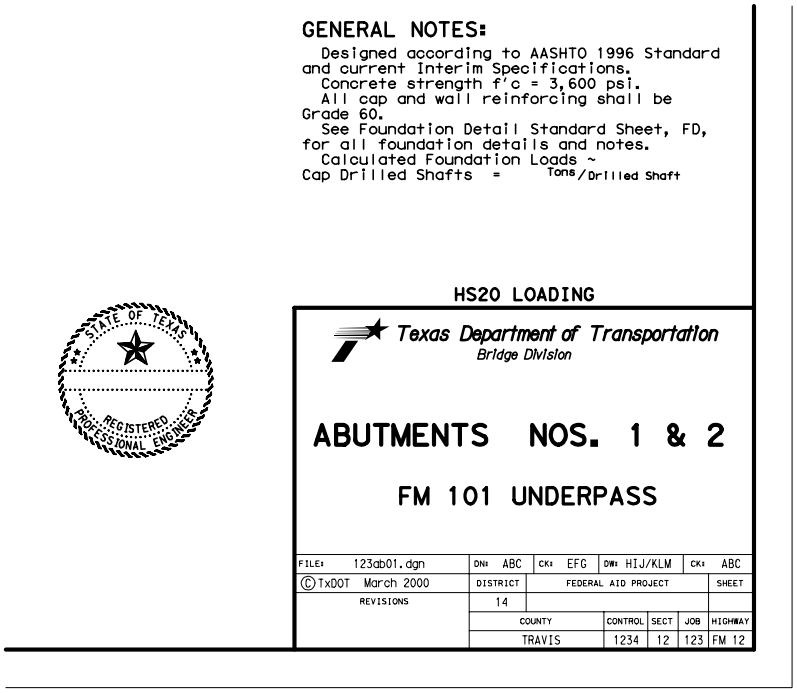


Figure 3-34: General Notes, Title Block, and P.E. Seal. Online users can click 3-34 to view this illustration in PDF.

Chapter 4
Interior Bents

Contents:

Section 1
General Information

Preferred Interior Bent Scales

The Interior Bent Details Sheet shall be accurate drawn to scale and shall normally contain, but is not limited to, the following listed details (showing preferred scales):

Table 4-1: Interior Bent Scales

Details	Preferred Scale
Plan View	3/8" = 1'-0"
Elevation View (including column elevation and section)	3/8" = 1'-0"
Cap Section	1/2" = 1'-0"
Bar Details	3/4" = 1'-0", 1/2" = 1'-0"
Bearing Seat Detail	3/4" = 1'-0"
Table of Constant Quantities	
Table of Variable Quantities	
Table of Total Quantities	
General Notes	

Dimensions shall normally be shown on the Interior Bent Details Sheet as listed below:

- Structural dimensions and foundations locations - In the plan view, dimensions transverse to the roadway and column/foundation locations in decimal feet to the nearest 0.001'. All other details, including dimensions across cap width in plan view, shall be shown in feet and inches to the nearest 1/4" (see Section 5 - under Table of Column Information for column sizes).
- Reinforcing steel - Rebar dimensions and locations in all views, including bar details, shall normally be in feet and inches to the centerline of the rebar.
- Cover - Cover on rebars shall normally be 2 1/4" to the centerline of the rebar. Cover on the Z bar in columns is 3" to centerline (see Chapter 1, Section 6, for cover requirements for reinforcing steel).
- Angles - in degrees, minutes, seconds to the nearest whole second, if such accuracy is available

NOTE: For information about concrete slab and girder, box beam, or double-T interior bents, use Bridge Division standards as examples.

Section 2
Simple Interior Bent Sheets

Simple Interior Bent Examples

These sheets are included to provide examples of the drafting layout of a typical Bridge Interior Bent Sheet. See the various sections of this chapter for directions on drawing particular details. Note that interior bents are normally detailed facing the direction of increasing stations.

2'-9" Cap Example

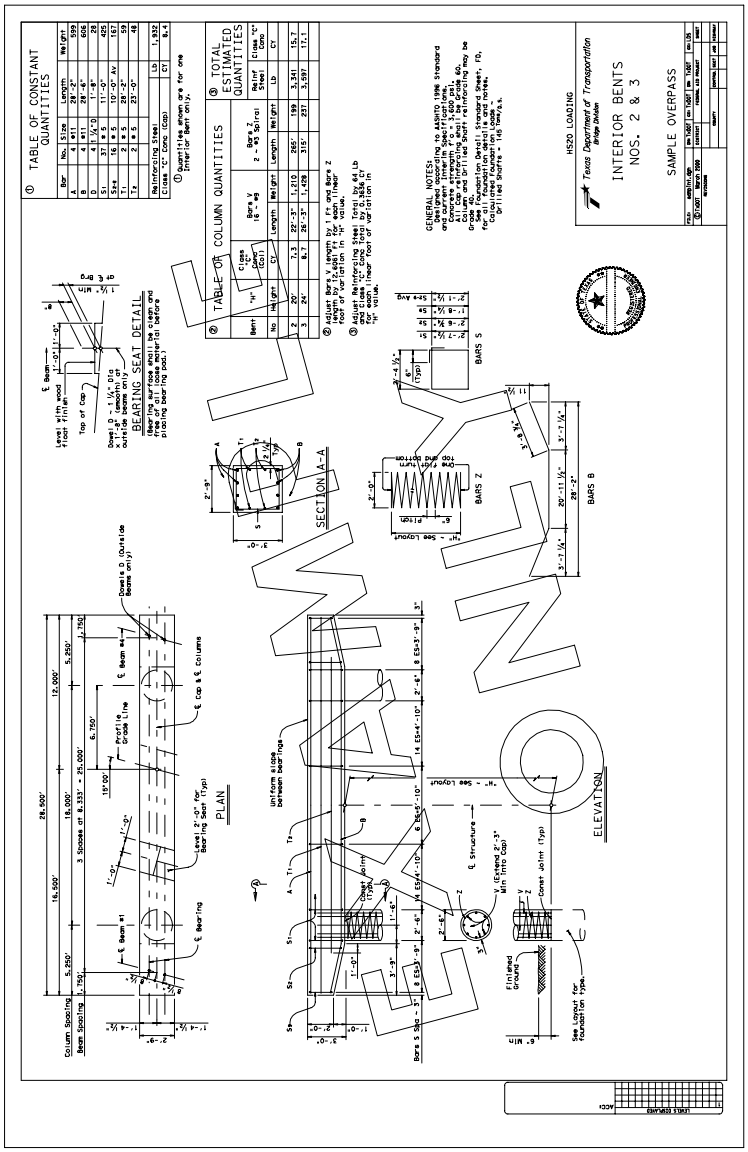


Figure 4-1: 2'-9' Cap Example. Online users can click 4-1 to view this illustration in PDF.

3'-3" Cap Example

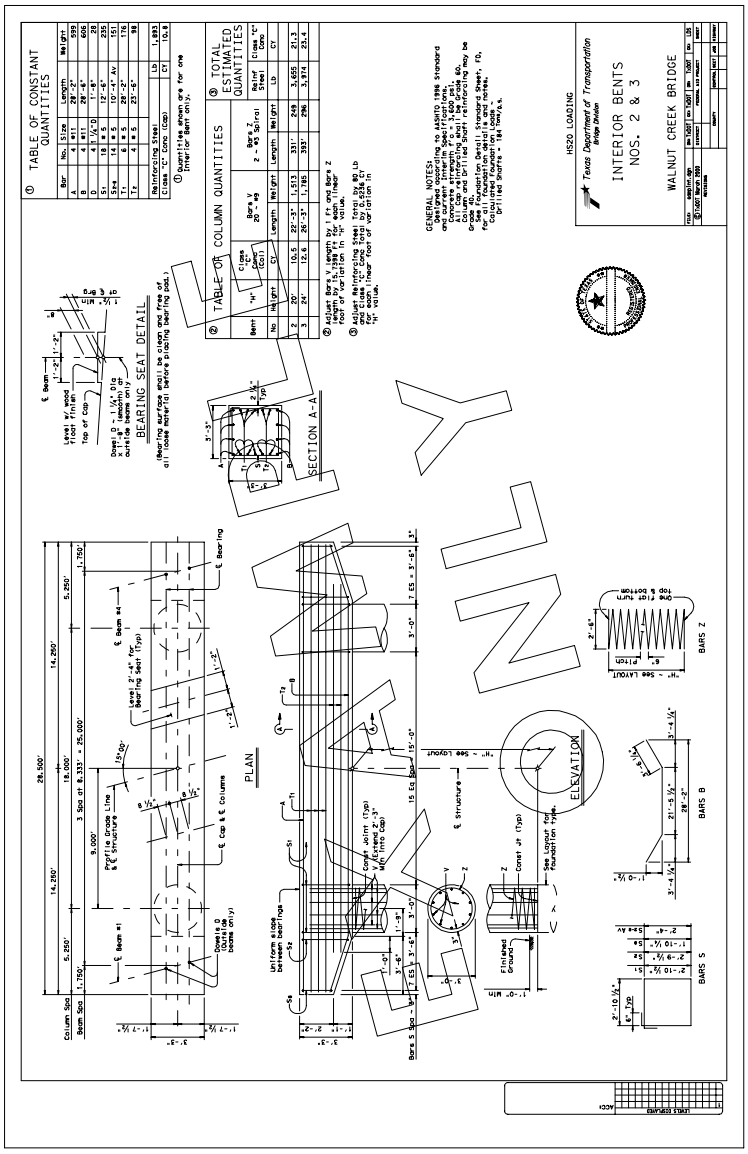


Figure 4-2: 3'-3" Cap Example. Online users can click 4-2 to view this illustration in PDF.

Section 3
Sheet Checklist

Plan View

Accurate, measurable detail, with exceptions to enhance clarity

1. ☐ Label the control line (matching the terminology on the layout, such as reference line, centerline, or profile grade line).

2. ☐ Control dimensions shall be referenced to a working point (usually the intersection of the control line and the centerline of the bent).

3. ☐ Overall length of cap dimensioned along the centerline of the bent

4. ☐ Working point dimensioned in relation to overall length of cap

5. ☐ Beam lines located and dimensioned along the centerline of the bent (outside beam lines labeled with beam number)

6. ☐ Columns located and dimensioned at the centerline of each column, along the centerline of the bent. Column spacing must be designed for each combination of roadway width, skew, beam type, span lengths, cap sizes, etc. (round spacing to 3", if practicable). In addition to all other dimensions shown on the plan view, give a dimension from survey line, (centerline, baseline, profile grade line, etc.) to the nearest column/foundation.

7. ☐ Cap width dimensioned

8. ☐ Centerline of cap labeled and dimensioned

9. ☐ Centerline of bearing labeled, and dimensioned (normally 8 1/2", measured from the centerline of the bent along the centerline of the beam)

10. ☐ Typical bearing seat dimensioned and labeled (and, if present, dowels D labeled and located). Dowels D will not be used at the ends of multiple span units.

11. ☐ Skew angles (on structures with curved control lines, the angle is between a perpendicular to the centerline of cap at the working point and a tangent to the horizontal curve of the control line at the working point.) For varying beam angles add the following note:
"See Beam Layout for beam angles."

Elevation View

Accurate, measurable detail, with exceptions to enhance clarity

1. ☐ Cap and cantilever depths dimensioned
2. ☐ Label uniform slope between bearings
3. ☐ Stirrups detailed and dimensioned
4. ☐ Main cap reinforced (bars A and B) and temperature steel (bars T) detailed. Dimension beginning and ends of short reinforcing only.
5. ☐ Typical column (and, if present, web wall or crash wall) elevation and section detailed and dimensioned
6. ☐ "H" height dimensioned (typically aligned with the working point at the bottom of the cap)
7. ☐ Dimension ground line at column base (typically 1'-0" in a channel and 6" otherwise)
8. ☐ Specially designed foundations detailed and dimensioned (Typical foundation details need not be detailed. Refer to the Common Foundation Details Standard Sheet, FD, in the general notes.)
9. ☐ Location of required construction joints (do not detail bar laps at joints unless staged construction is used)
   NOTE: A construction joint is required for overall cap length of approximately 85' and over.
10. ☐ Identify main section location

Other Details

Accurate, measurable detail, with exceptions to enhance clarity

1. ☐ Main section details ("Section A-A")
2. ☐ Wall details, if applicable
3. ☐ Bar details
4. ☐ Bearing seat detail
5. ☐ Tables of quantities
6. ☐ General notes (including, but not limited to, design criteria, loading, class of concrete, foundation loads, and cross references to various standard sheets)
7. ☐ Title block, information block, and engineer's seal

Final Checks

1. ☐ Check all details and dimensions against superstructure to ensure the details are not in conflict.
2. ☐ Double check bars in various details against the number of bars shown in the quantity tables.
3. ☐ Ensure that the name of the bridge is the same on all detail sheets.
4. ☐ Initial the sheet after back-checking corrected details.

Section 4
Normal Parameters

Typical Elevation and Section

Normal interior bent parameters are as follows:

- 2'-9" - normal cap width, type A, B, and C beams
- *3'-0" - normal minimum cap depth, type A, B, and C beams
- 2'-6" - normal column diameter for 2'-9" cap width
- 3'-3" - normal cap width, type IV beams
- *3'-3" - normal minimum cap depth, type IV beams
- 3'-0" - normal column diameter for 3'-3" cap width
- 1'-9" - minimum distance from centerline of outside beam to end of cap
- 6" - minimum below finished ground line, column to foundation joint
- 1'-0" - minimum below grade in channel, column to foundation joint

*Increase cap depths by 3" increments as needed.

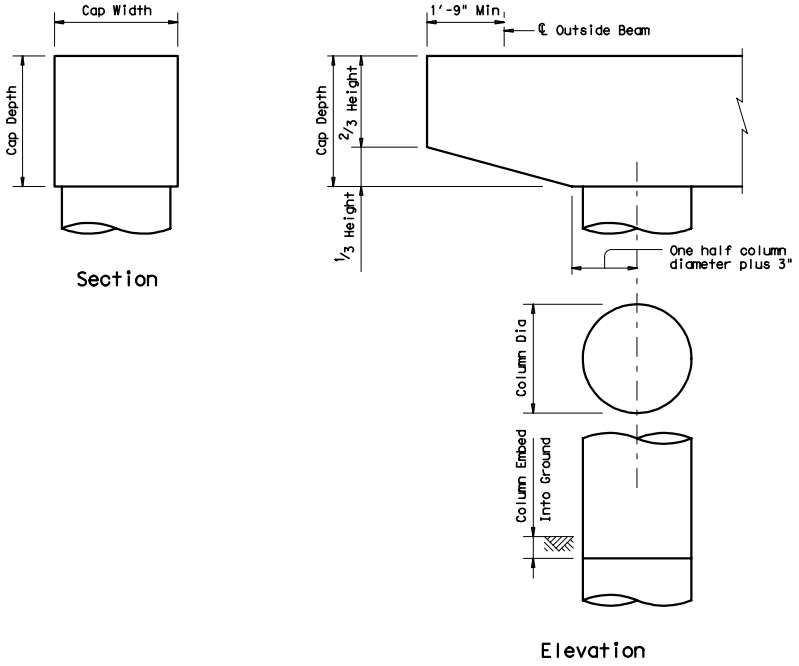


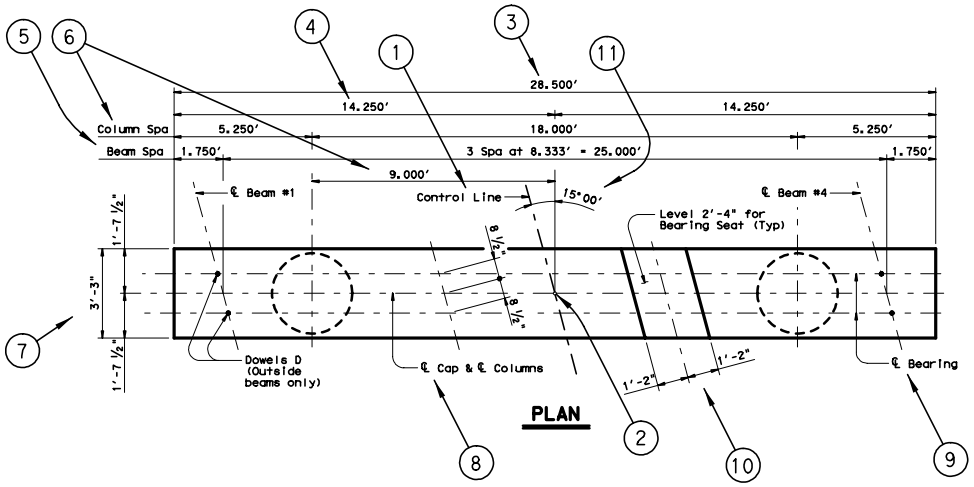
Figure 4-3: Typical Elevation and Section. Online users can click 4-3 to view this illustration in PDF.

Section 5
Simple Interior Bent

Plan View Example

The plan view checklist , presented in Section 3, should be followed to ensure that the details are accurate and complete. Note that, excepting dowels D, reinforcing will normally not be shown on the plan view.

NOTE: An example bent for type IV beams is shown and all dimensions are for example only.



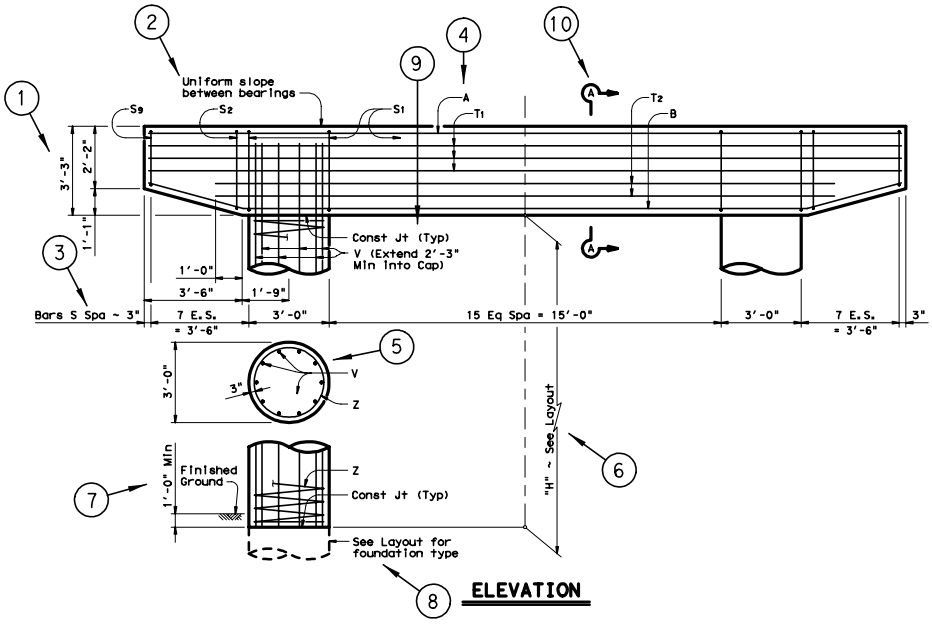
1	Control line (Station Line or PGL)	7	Cap widths dimensioning
2	Working point	8	Cap centerline located
3	Overall dimensioning	9	Centerline of bearing located
4	Working point dimensioning	10	Typical bearing seat
5	Beam spacing dimensioning	11	Skew angle
6	Column spacing dimensioning		

Figure 4-4: Plan View, Checklist Items. Online users can click 4-4 to view this illustration in PDF.

Elevation View Example

The elevation view checklist, presented in Section 3, should be followed to ensure that the details are accurate and complete. Excepting Dowels D, reinforcing will normally be shown on the elevation view.

NOTE: An example bent for type IV beams is shown and all dimensions and bars spacing is for example only. See Section 8 - Bar Details for reinforcing bar locations and spacing.



1	Cantilever dimensions	6	"H" height
2	Slope label	7	Ground line
3	Stirrup dimensioning	8	Foundation reference
4	Main & temperature steel	9	Construction joints
5	Typical column	10	Main section marks

Figure 4-5: Elevation View, Checklist Items. Online users can click 4-5 to view this illustration in PDF.

Main Section Examples

Main sections should be accurately detailed similar to the details shown below, normally at 1/2" = 1'-0" scale. Reinforcing spacing dimensions will normally not be shown on the section. See Section 8 - Bar Details for reinforcing bar location and spacing.

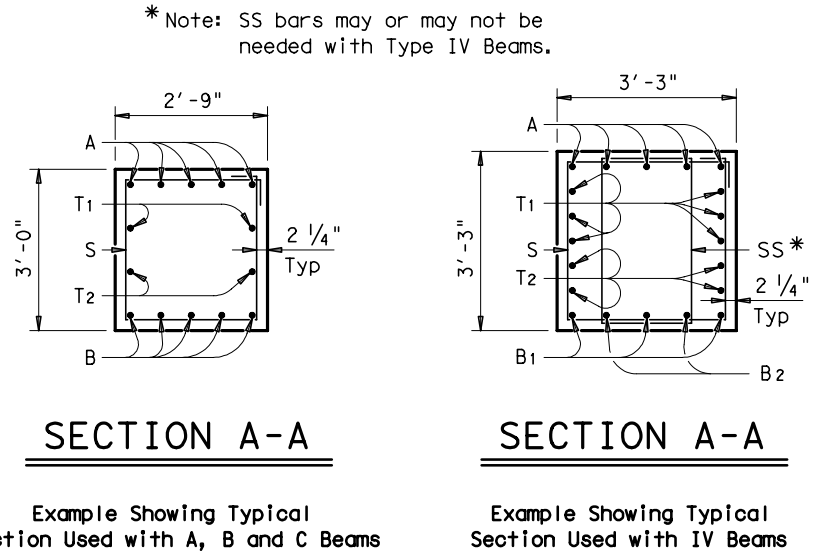


Figure 4-6: Main Section Examples. Online users can click 4-6 to view this illustration in PDF.

Column Information

Vertical column reinforcing (bars V), although Grade 60 by specification, is typically designed as Grade 40 to permit the utilization of shorter lap and embedment lengths.

For conventional interior bent caps with moderate column spacing and heights not exceeding 30 feet for A, B, and C beams, use 30" diameter columns. Use 36" diameter columns for heights not exceeding 36 feet with American Association of State Highway and Transportation Officials (AASHTO) type IV beams.

Table 4-2: Table of Column Information

Column and Drilled Shaft Diameter	Class C Concrete	Vertical Reinforcing Bars V			Spiral Reinforcing Bars Z				
	CY per Linear Foot Column	No. of Bars	Size	% Ac	Size	Pitch	Spiral Diameter	Length per LF Column	Length of 2 Flat Turns
1'-6" (18")	0.0654	6	#6	1.04	#3	6"	1'-0"	6.3623'	6.2832'
2'-0" (24")	0.1164	8	#7	1.06	#3	6"	1'-6"	9.4777'	9.4248'
2'-6" (30")	0.1818	8	#9	1.13	#3	6"	2'-0"	12.6061'	12.5664'
3'-0" (36")	0.2618	10	#9	0.98	#3	6"	2'-6"	15.7398'	15.7080'
3'-6" (42")	0.3563	14	#9	1.01	#3	6"	3'-0"	18.8761'	18.8496'
4'-0" (48")	0.4654	18	#9	0.99	#3	6"	3'-6"	22.0139'	21.9911'
4'-6" (54")	0.5890	16	#11	1.09	#4	9"	4'-0"	16.7850'	25.1327'
5'-0" (60")	0.7272	20	#11	1.11	#4	9"	4'-6"	18.8761'	28.2743'
NOTE: Quantities shown are for one column only.									

Section 6
Inverted-T Cap Details

Plan View Example

The plan view checklist , presented in Section 3,, should be followed to ensure that the details are accurate and complete. Note that, excepting dowels D, reinforcing will normally not be shown on the plan view.

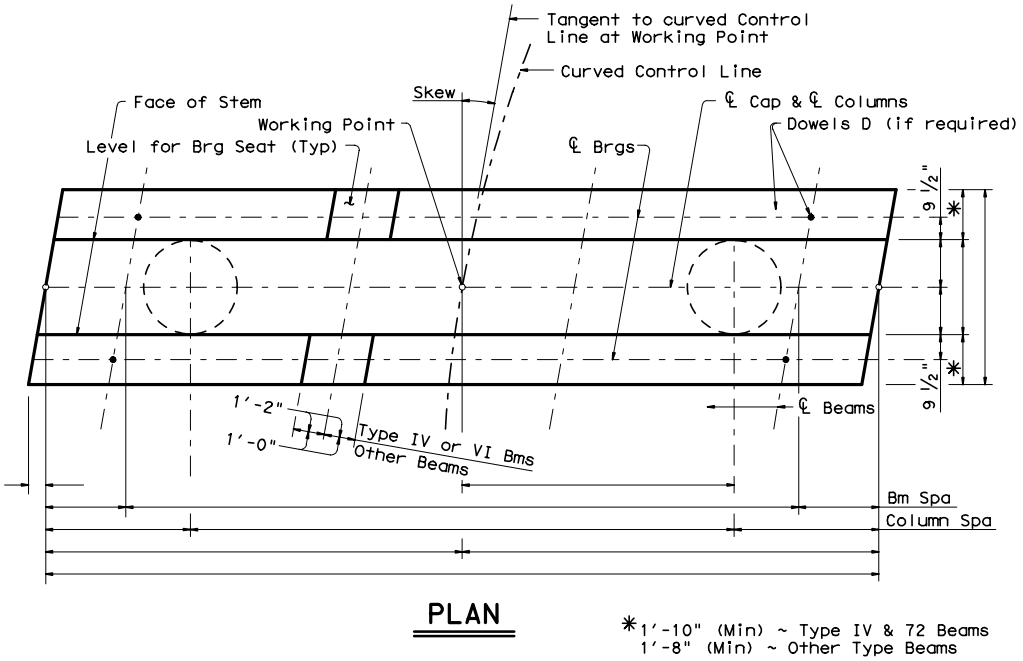


Figure 4-7: Plan View Example. Online users can click 4-7 to view this illustration in PDF.

Cap lengths, drilled shaft spacing and beam spacing are measured along the centerline of cap.

Interior bent plan view is normally shown as above, facing the direction of increasing stations. Ends of the cap may be square or skewed as directed by the designer. Show offset dimension on skewed ends.

Reinforcing is not normally shown in the plan view (except for beam dowels D, if required).

Partial Elevation View

Cap dimensions, bar sizes, and spacing are as directed by engineer.

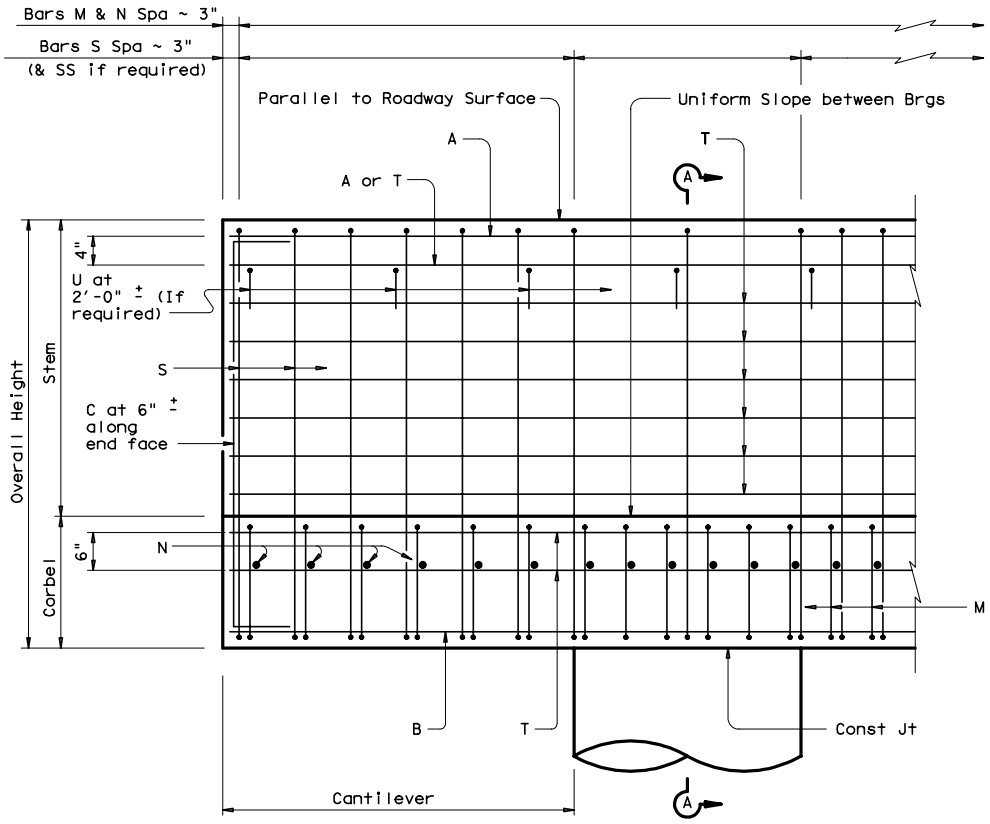


Figure 4-8: Partial Elevation View. Online users can click 4-8 to view this illustration in PDF.

Section A-A Example

Dimensions, bar spacing, and bar sizes are as directed by the designing engineer, except when minimum values are shown.

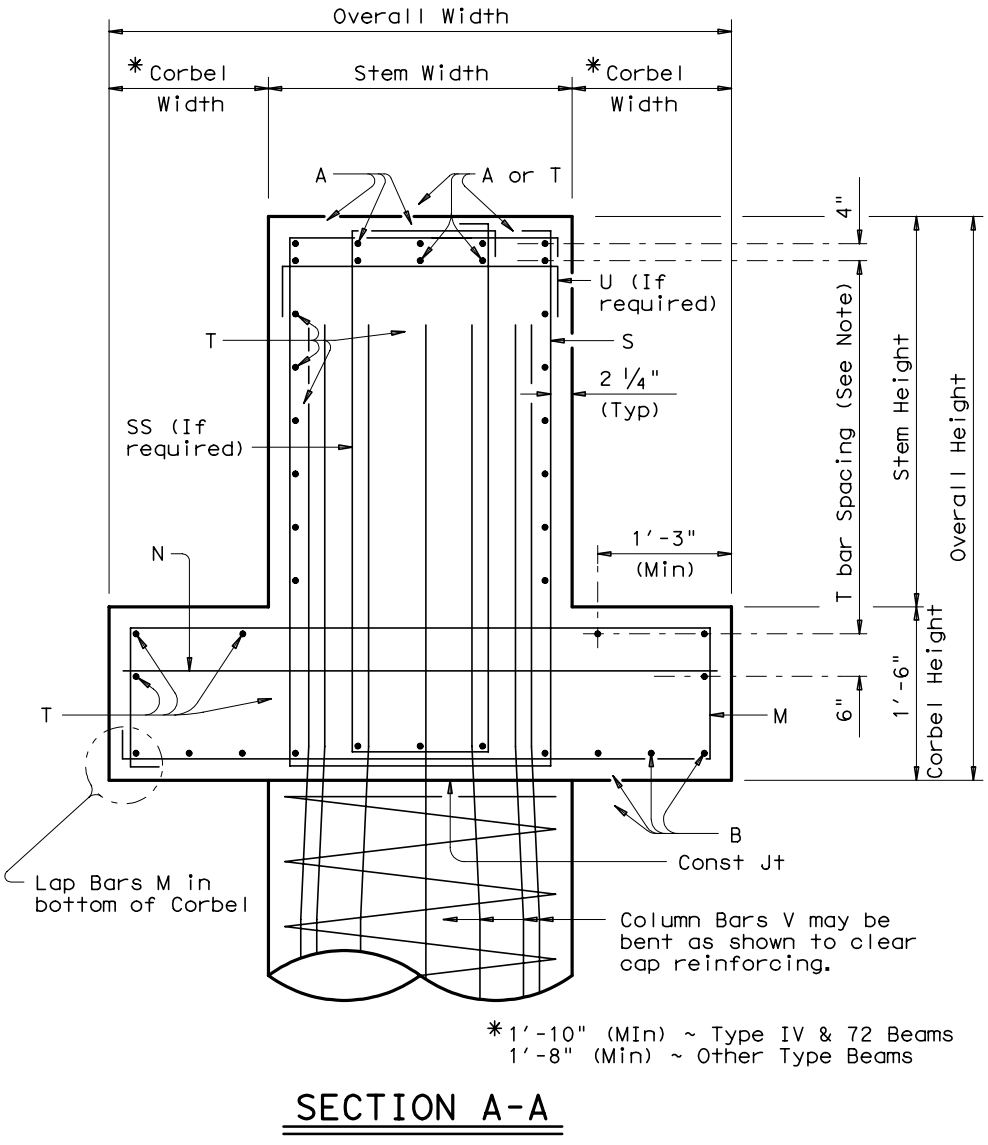


Figure 4-9: Section A-A Example. Online users can click 4-9 to view this illustration in PDF.

Section 7
Wall Details

Web Wall Parameters and Example

Web walls are normally used to strengthen the columns of a multi-column bent against drift carried by flood water. The wall shall be placed between the columns, parallel with the direction of flow.

A standard web wall shall be a minimum of 1'-3" thick. The wall shall extend a minimum of 1 foot below finished grade. Most web walls shall extend the full height of the columns to the bottom of the cap. At tall piers, the wall may extend a minimum of 3 feet above estimated high water. If the wall is located in an area subject to tides, the top of the wall shall normally be set to a minimum of 6 feet above mean high tide.

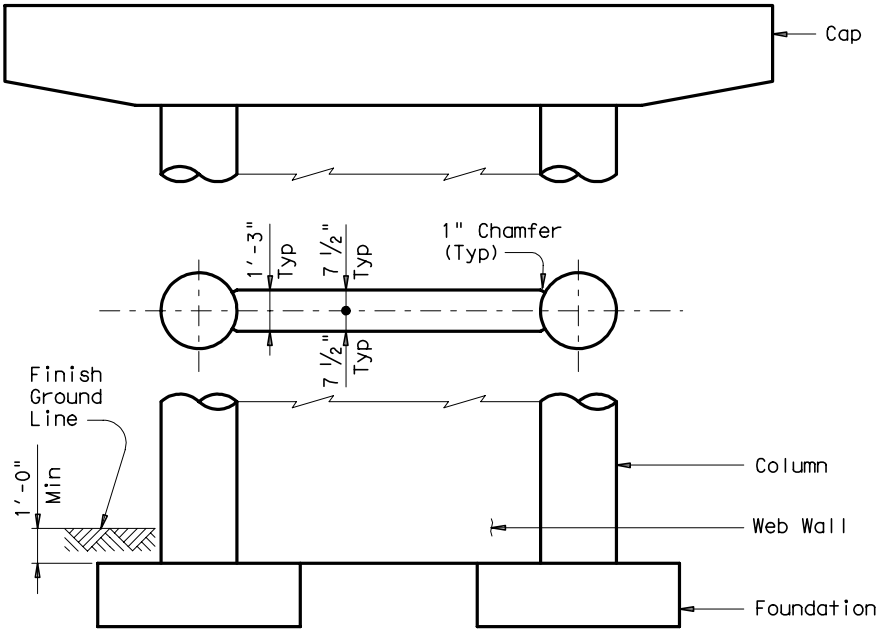
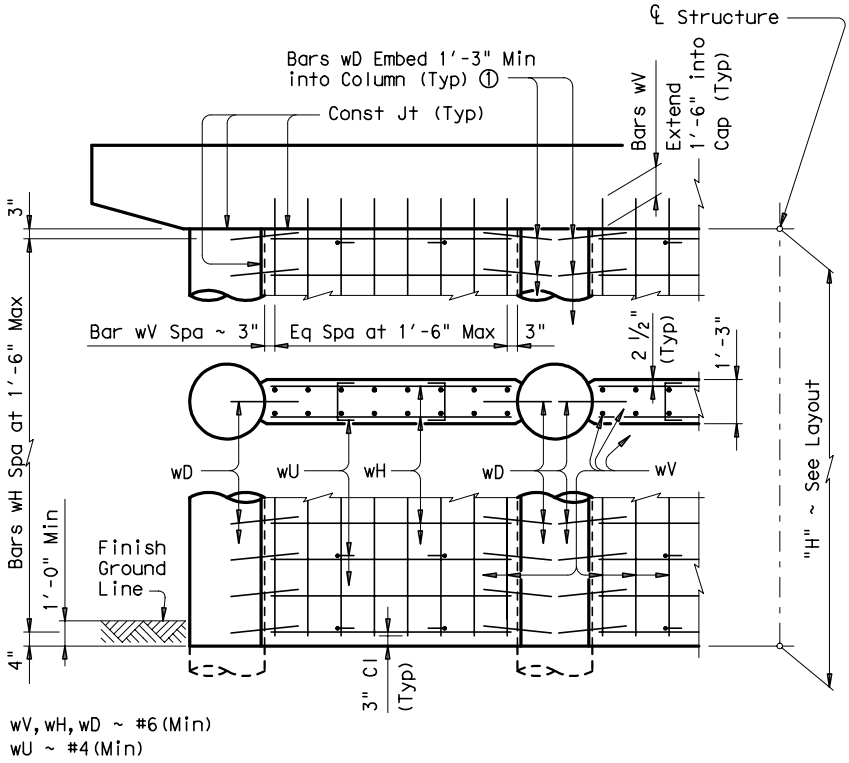


Figure 4-10: In-Channel Web Wall Parameters for Multi-Column Bent. Online users can click 4-10 to view this illustration in PDF.

Web walls should be accurately detailed similar to the details shown below and are normally included in the elevation views. If required for clarity, the wall details may be shown on a separate view or sheet.

Quantities for web walls should be included in the Table Of Variable Column Quantities or, if a separate sheet is used for the wall details, the quantities should be placed on a variable wall quantities table with the details.



① At Contractor's option, bars wD may be placed with the column or may be drilled and grouted with the anchorage end sloped 1:6 into column. On interior columns, the contractor has the option to place one bar passing through the forms instead of two opposing bars.

Figure 4-11: Example Showing Typical In-Channel Web Wall. Online users can click 4-11 to view this illustration in PDF.

Crash Wall Parameters and Example

The following information has been extracted from the current American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering and is intended only as a guide to the minimum requirements for crash walls for detailing purposes. The engineer should follow the **AREMA** specifications and the specific railroad requirements in identifying the need for and the designing of crash walls.

Crash walls for piers located from 12 to 25 feet from the centerline of track shall have a minimum height of 6 feet above the top of rail. Piers less than 12 feet from the centerline of track shall have a minimum crash wall height of 12 feet above the top of rail.

The face of the crash wall shall present a smooth surface, extending a distance of at least 6 inches beyond the face of the column on the side of the wall adjacent to the track. The crash wall shall extend at least 4 feet below the lowest surrounding grade. The wall shall be anchored to each column (and footing) as shown hereafter.

The crash wall shall be at least 2'-6" thick. When a pier consists of a single column, the crash wall shall be a minimum of 12 feet in length, parallel to the track, and centered longitudinally on the pier. When two or more light columns compose a pier, the crash wall shall connect the columns and extend at least 1 foot beyond the outermost columns, parallel to the track.

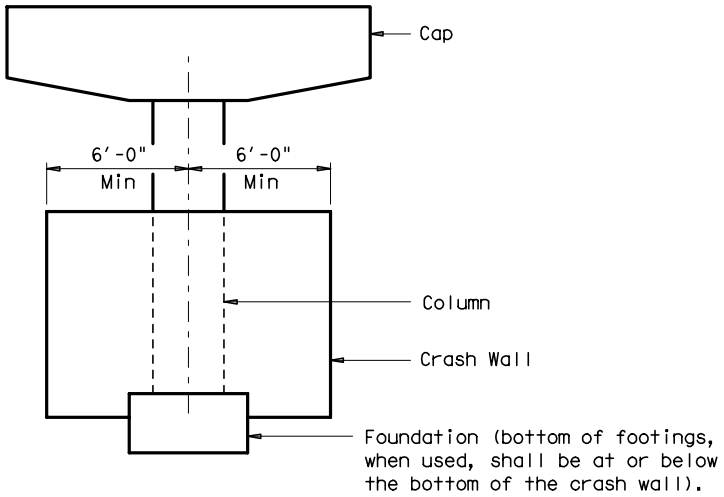


Figure 4-12: Railway Crash Wall Parameters for Single Column Bent. Online users can click 4-12 to view this illustration in PDF.

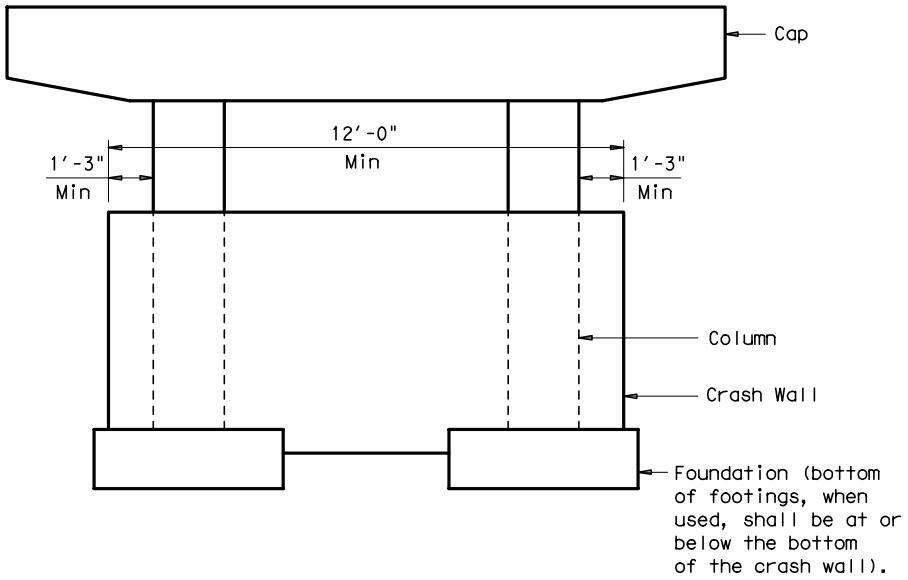


Figure 4-13: Railway Crash Wall Parameters for Multi-Column Bent. Online users can click 4-13 to view this illustration in PDF.

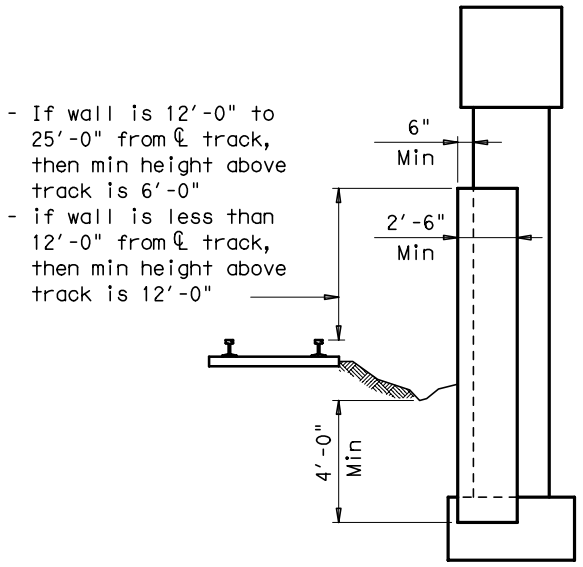


Figure 4-14: Railway Crash Wall Parameters Bent End Elevation. Online users can click 4-14 to view this illustration in PDF.

Crash walls should be accurately detailed similar to the details shown below and are normally included in the elevation views. If required for clarity, the wall details may be shown on a separate view or sheet.

Quantities for crash walls should be included in the Constant Quantities Table or, if a separate sheet is used for the crash wall details, the quantities should be placed on a wall quantities table with the details.

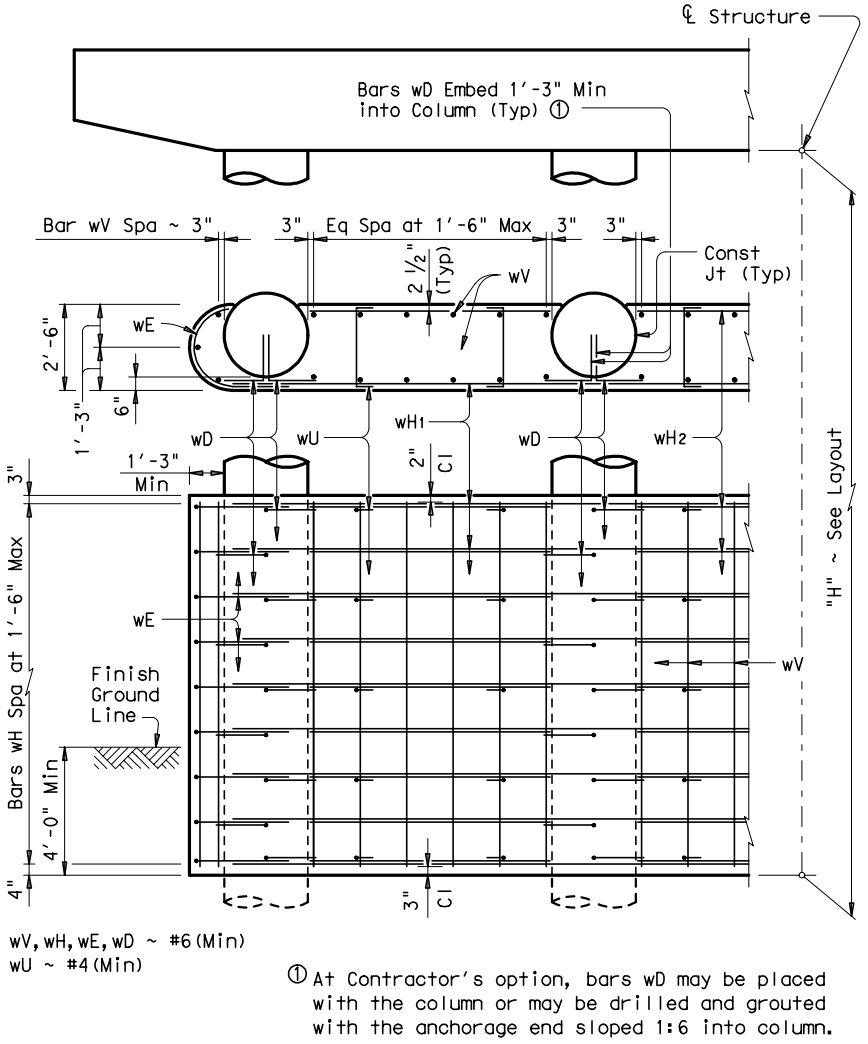


Figure 4-15: Example Showing Typical Crash Wall. Online users can click 4-15 to view this illustration in PDF.

Section 8
Bar Details

Typical Bar Sizes for Interior Bents

The information in this section shows typical interior bent reinforcing and its placement. The rebar weights, bends, and locations may, however, be different from that given due to structural design requirements.

Interior bent reinforcing typical bar sizes are as follows.

Table 4-3: Typical Bar Sizes

Bars	Typical Size
Bars A	#11
Bars B	#11
Bars D	1 1/4" diameter (1'-8" normal length)
Bars S	#5
Bars T	#5
Bars V	#9*
Bars Z	#3*
Bars wD	#6
Bars wE	#6
Bars wH	#6
Bars wU	#4
Bars wV	#6
*Typical column reinforcing (see Table of Column Information for other column size requirements)	

Details need not be shown on the plan sheet for straight bars unless the bars are lap spliced and the location of the lap is significant.

The maximum length of a rebar, without the requirement for a bar lap, is 60 feet.

Bars A Details

"Bars A" is the normal designation for the top main cap reinforcing. Bars A fit within the cap stirrups (bars S) and shall end as shown below. A detail for bars A is not required unless the bar is spliced. The bar dimensions shall be established such that the lap splice is in a compression area, normally centered between columns. If required, supplemental bars A shall be placed in a cap tension area, normally centered over interior columns. Dimension bar locations.

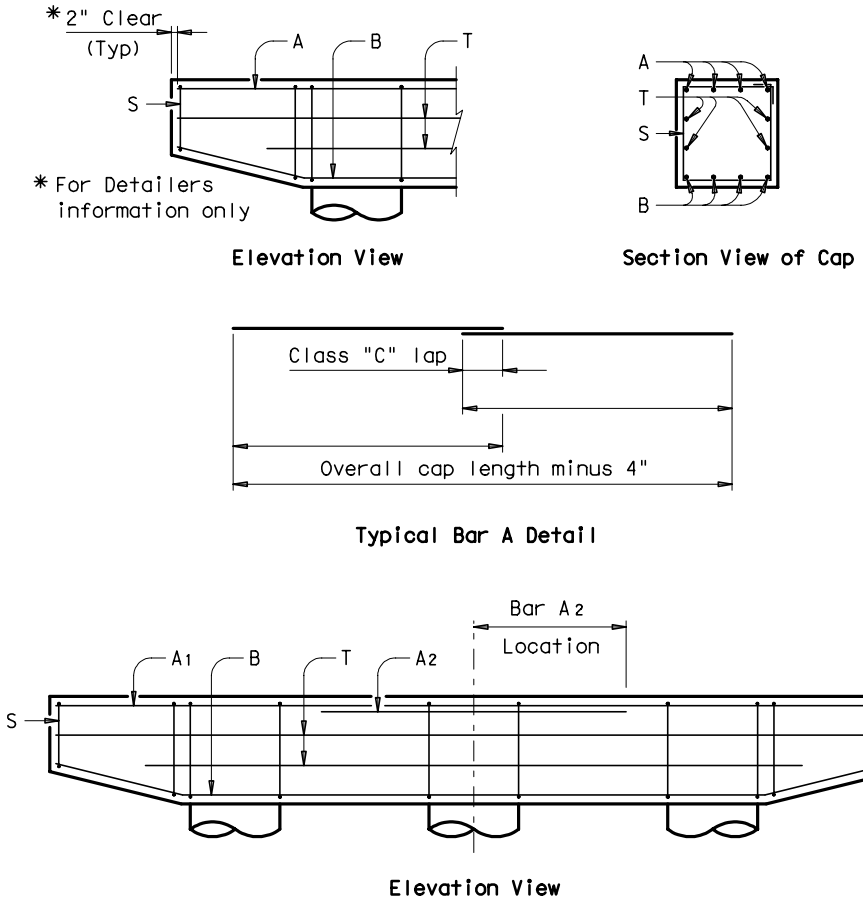


Figure 4-16: Bars A Details. Online users can click 4-16 to view this illustration in PDF.

Bars B Details

"Bars B" is the normal designation for the bottom main cap reinforcing. Bars B fit within the cap stirrups (bars S) and shall end as shown below. Details for all bent bars B are required. The bar dimensions shall be established such that the lap splice is in a compression area, normally adjacent to a column. If required, supplemental bars B shall be placed in a cap tension area, normally centered over interior columns. Dimension bar locations.

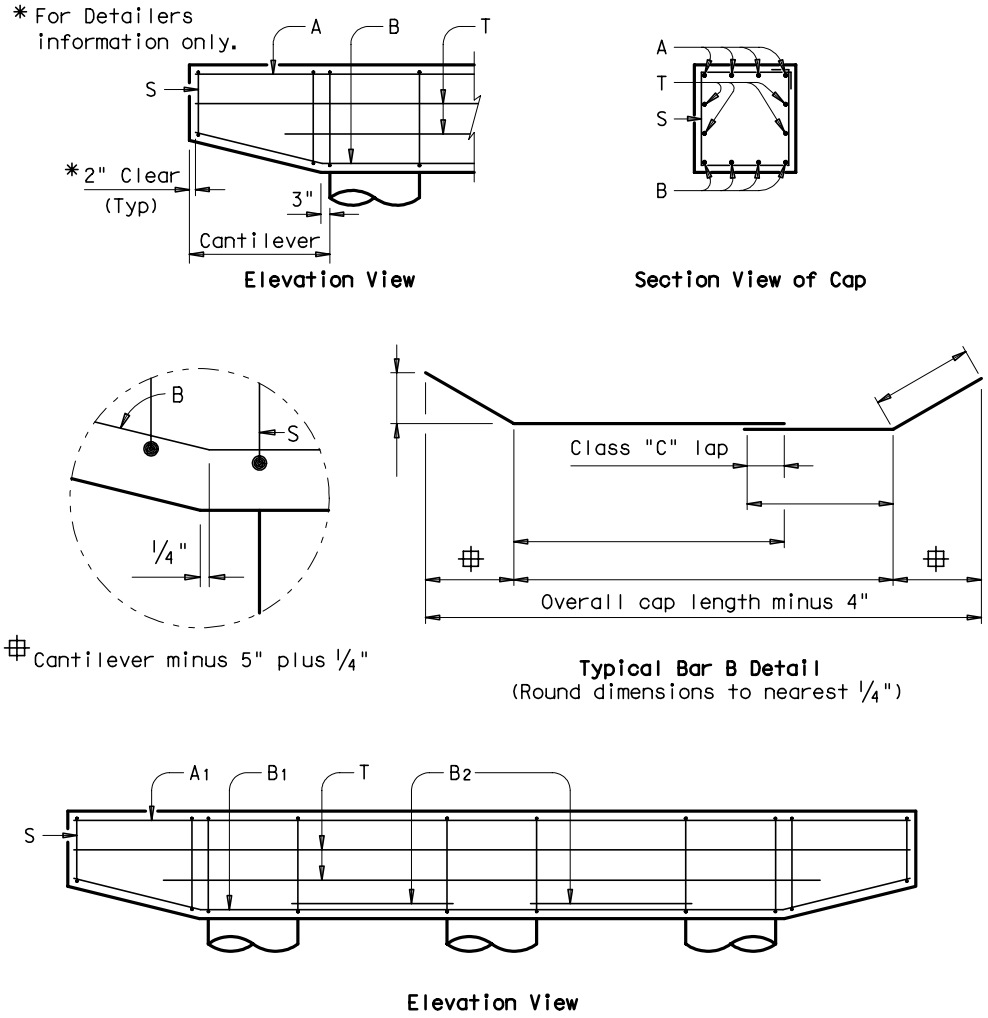


Figure 4-17: Bars B Details. Online users can click 4-17 to view this illustration in PDF.

Bars S Details

"Bars S" is the normal designation for the main cap stirrup reinforcing. Bars S fit around the columns as shown below. Supplemental bars SS (doubled bars S) may occasionally be required. These bars shall be included only when the cap design requires their presence. Bars SS are normally placed in regions of high shear where reinforcing spacing has become so tight as to interfere with concrete placement. Dimension bar locations on elevation view.

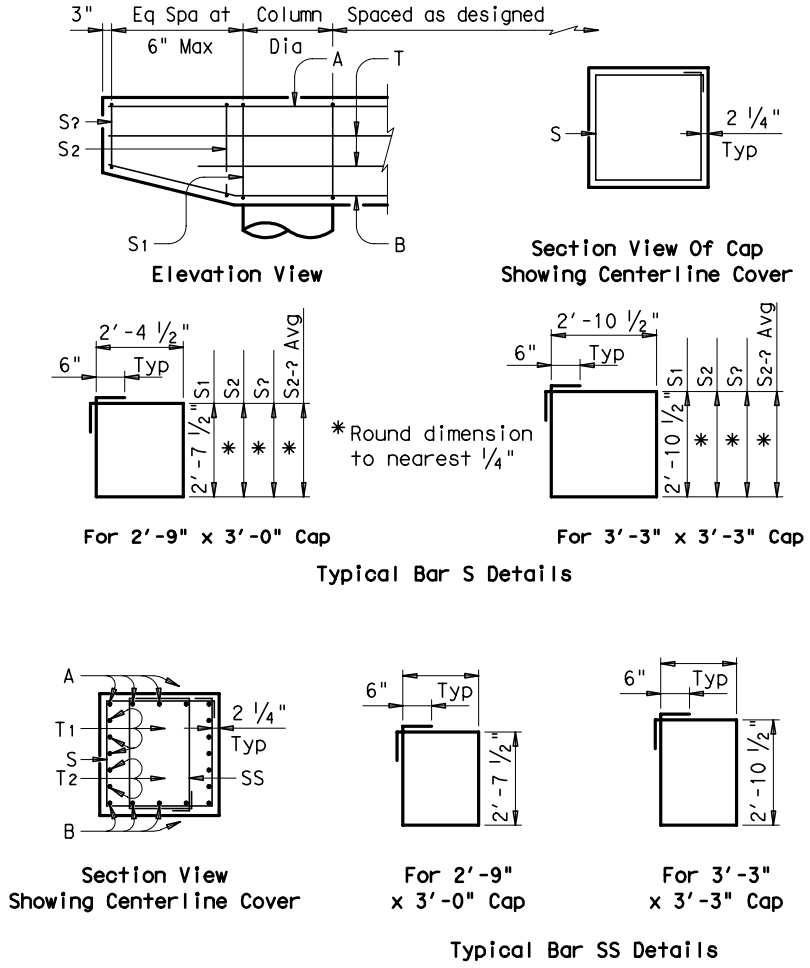


Figure 4-18: Bars S Details. Online users can click 4-18 to view this illustration in PDF.

Bars T Details

"Bars T" is the normal designation for the temperature reinforcing placed in the sides of the cap. Bars T fit within the stirrups as shown below.

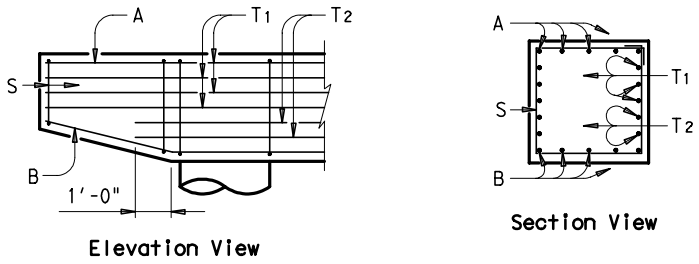


Figure 4-19: Bars T Details. Online users can click 4-19 to view this illustration in PDF.

Bars V Details

"Bars V" is the normal designation for the vertical reinforcing within a column. Bars V fit within the column spiral reinforcing as shown below. (See Column Information in Section 5 of this chapter for a table of the bar sizes required for column vertical reinforcing.) Note that drilled shafts of equivalent size use similar reinforcing.

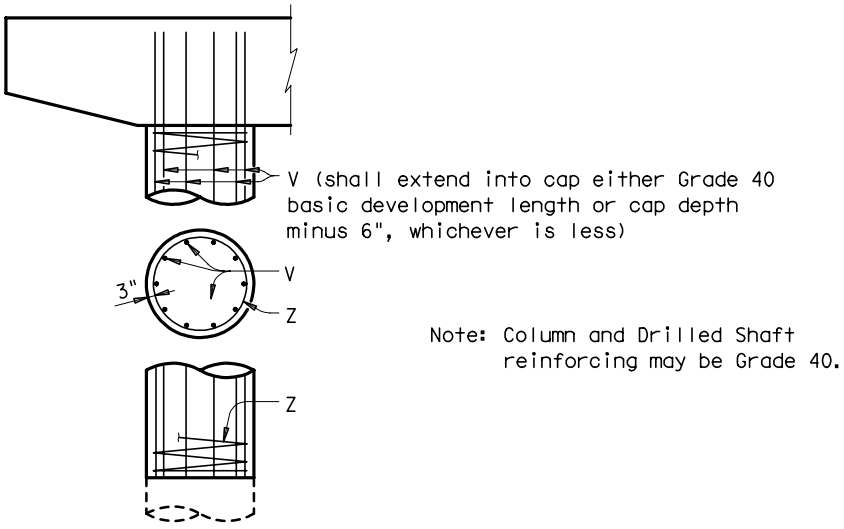


Figure 4-20: Typical Column Detail Showing Bars V. Online users can click 4-20 to view this illustration in PDF.

Bars Z Details

"Bars Z" is the normal designation for the spiral reinforcing within a column. (See Column Information in Section 5 of this chapter for a table of the bar sizes required for column spiral reinforcing.) Note that drilled shafts of equivalent size use similar reinforcing.

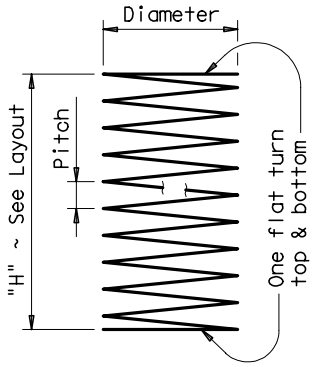


Figure 4-21: Typical Bars Z Detail. Online users can click 4-21 to view this illustration in PDF.

Bars wD Details

"Bars wD" is the normal designation for a wall to column connection. Bars wD spacing shall normally match bars wH spacing. Crash Wall bars wD shall normally require a bar detail.

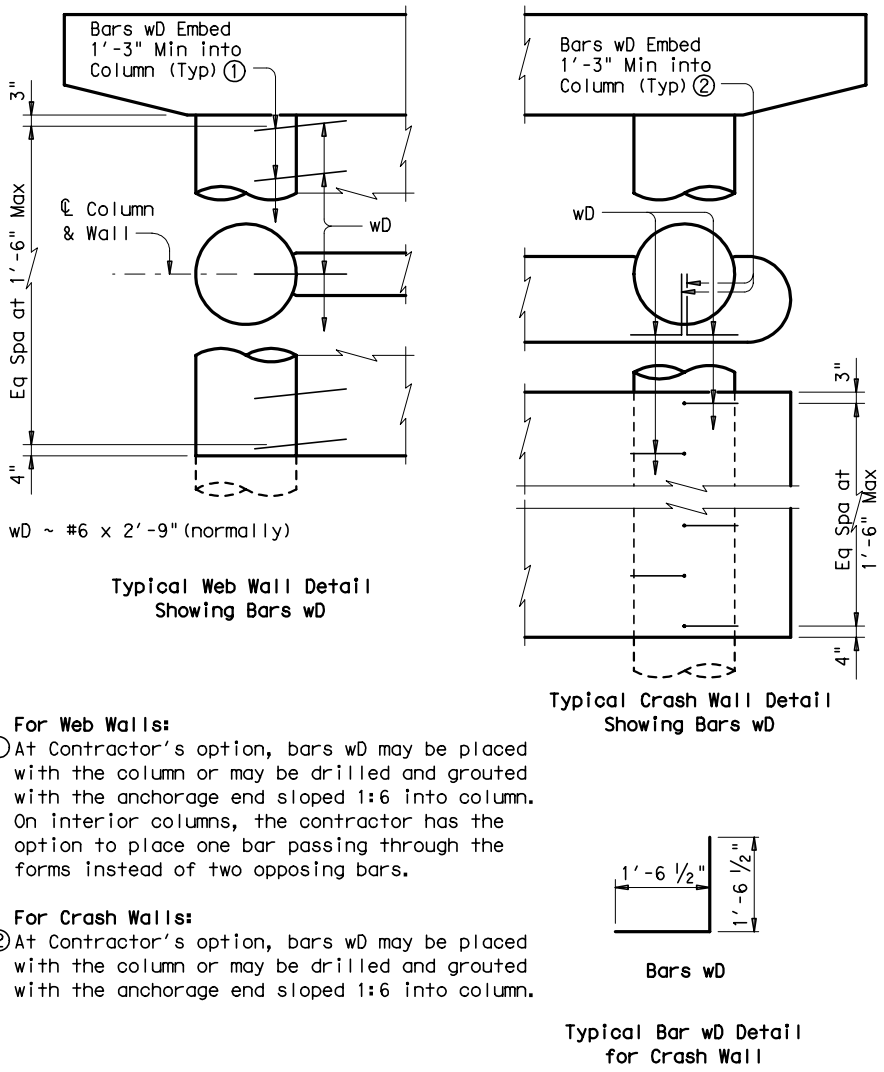
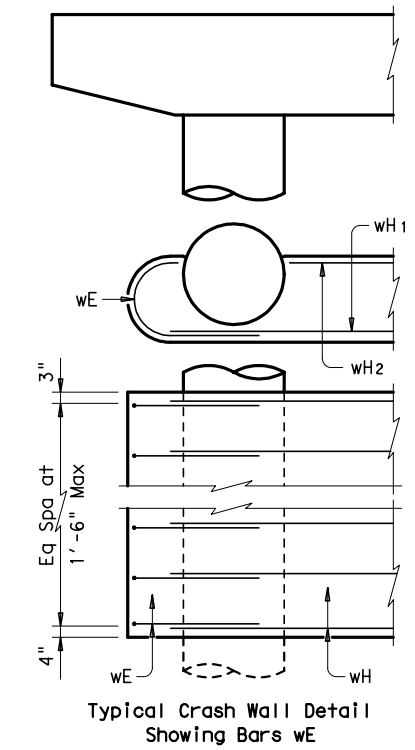


Figure 4-22: Bars wD Details. Online users can click 4-22 to view this illustration in PDF.

Bars wE Details

"Bars wE" is the normal designation for the reinforcing in the crash wall end face. Bars wE spacing shall normally match bars wH spacing. Crash Wall bars wE shall normally require a bar detail.



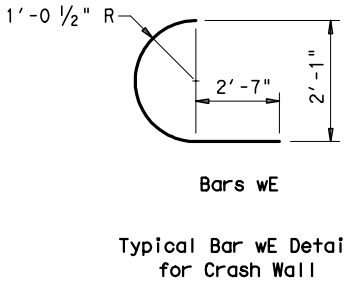


Figure 4-23: Typical Bar wE Detail for Crash Wall. Online users can click 4-23 to view this illustration in PDF.

Bars wH Details

"Bars wH" is the normal designation for the horizontal reinforcing in a web wall or crash wall. Bars wH shall be placed to the outside of bars wV. A detail for bars wH is normally not required.

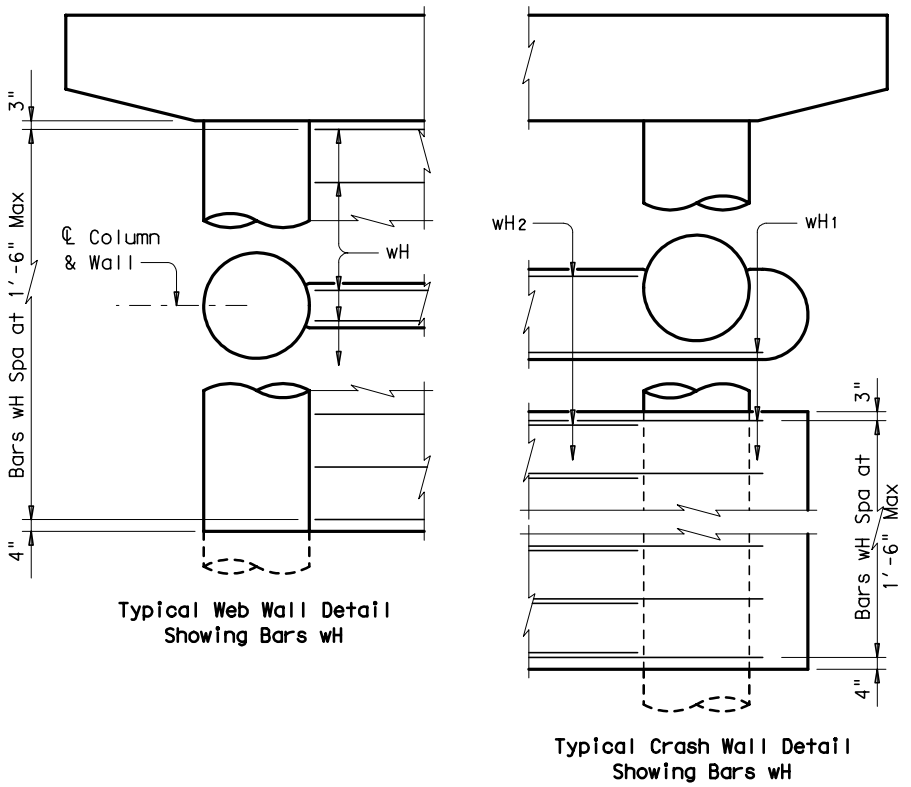


Figure 4-24: Bars wH Details. Online users can click 4-24 to view this illustration in PDF.

Bars wU Details

"Bars wU" is the normal designation for the tie bars in a web wall or crash wall that hold the reinforcing mats in position. Bars wU fit outside of the vertical reinforcing bars wV as shown below. Bars wU are spaced vertically at every other bar wH normally and spaced horizontally at every fourth bar wV normally. A detail for bars wU is normally required.

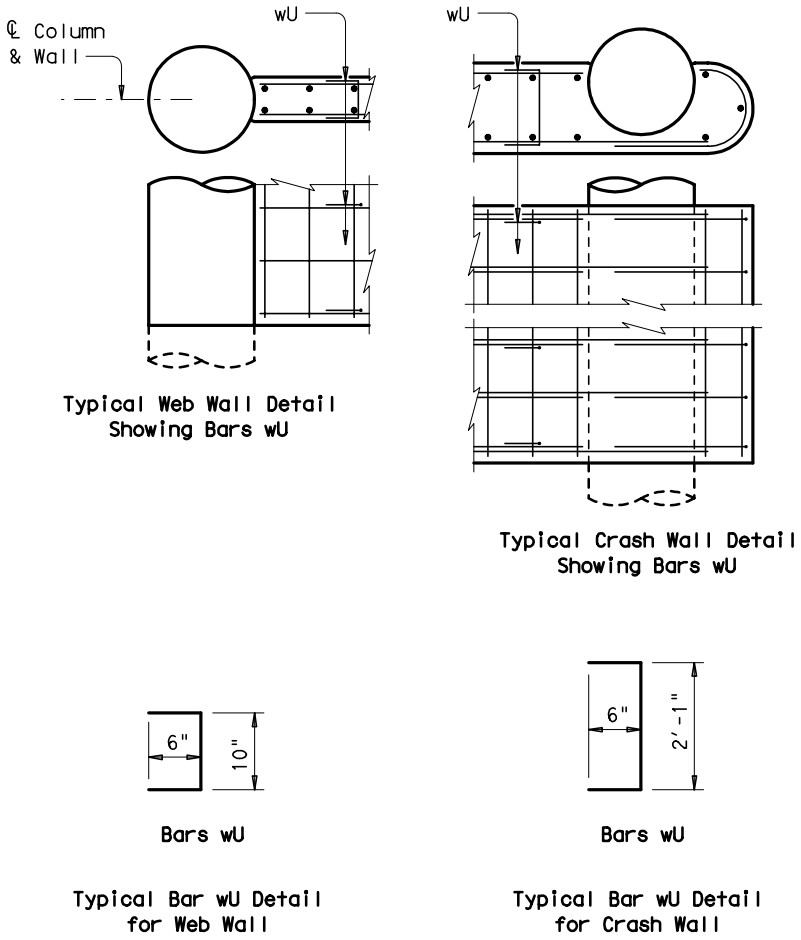


Figure 4-25: Bars wU Details. Online users can click 4-25 to view this illustration in PDF.

Bars wV Details

"Bars wV" is the normal designation for the vertical reinforcing in a web wall or crash wall. Bars wV shall be placed to the inside of the horizontal reinforcing bars wH as shown below. A detail for bars wV is normally not required.

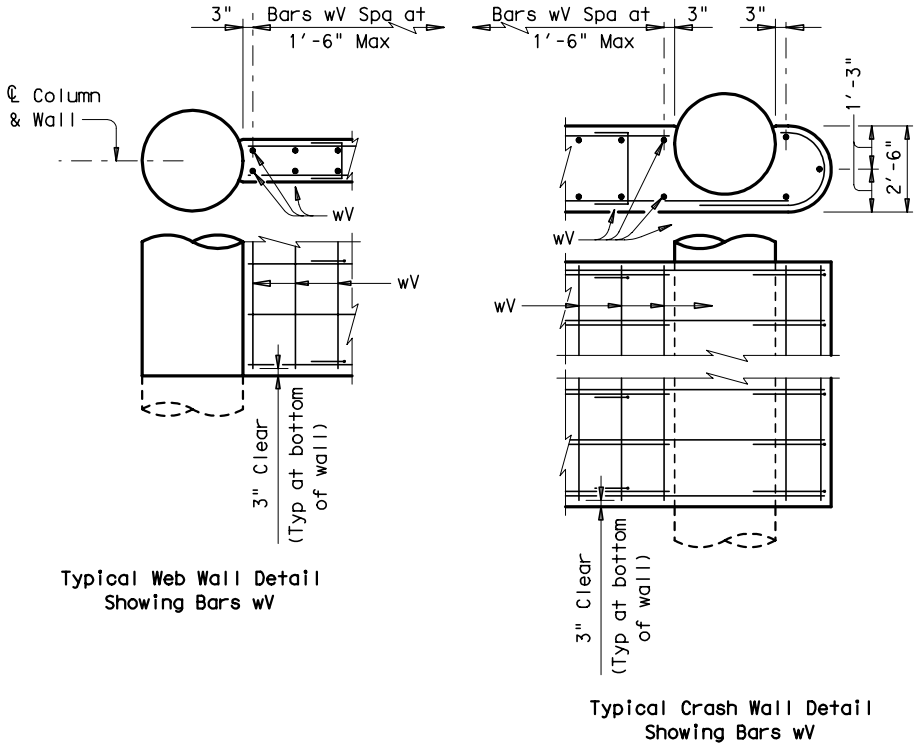


Figure 4-26: Bars wV Details. Online users can click 4-26 to view this illustration in PDF.

Section 9
Miscellaneous Details

Bearing Seat Details

Typical bearing seats shall normally be shown on the plan view as detailed below.

The beam spacing shall be measured along the centerline of the cap. The centerline of bearing shall be measured along the centerline of the beam. The buildup shall follow the skew of the beam. Buildup dimensions need be shown only once in this view. Details shown are for standard size caps. Larger caps or unusual details may require special details.

Dowels D shall normally be placed at outside beams only, although phased construction may require additional dowels. Dowels D shall not be used at the ends of multiple span units, but will be used at the ends of simple spans.

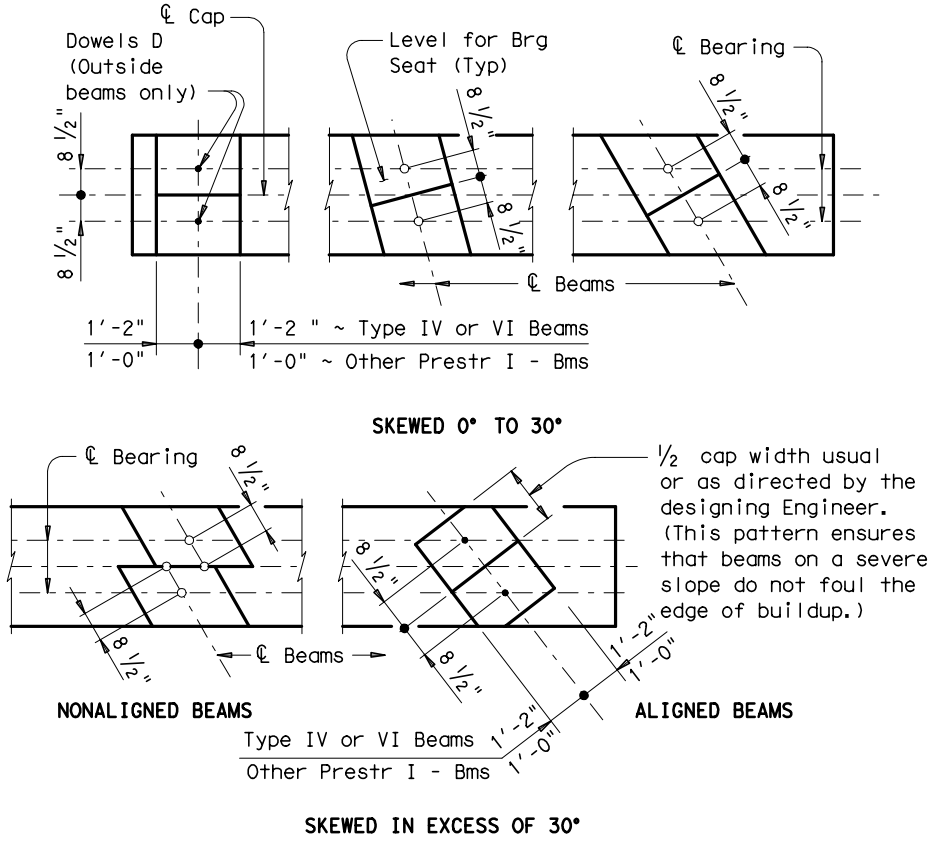


Figure 4-27: Typical Bearing Seat Plan Views. Online users can click 4-27 to view this illustration in PDF.

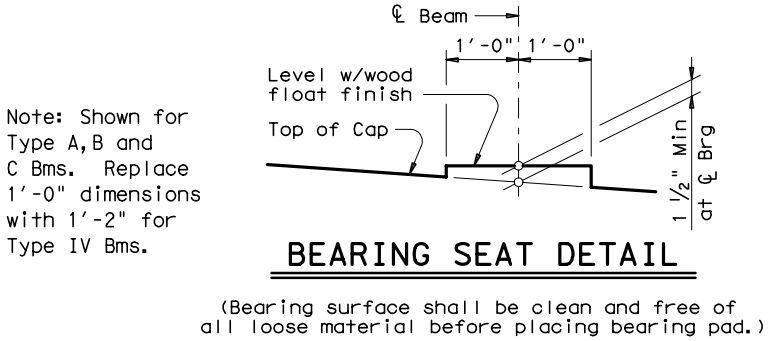


Figure 4-28: Standard Bearing Seat Elevation (with no dowel condition) . Online users can click 4-28 to view this illustration in PDF.

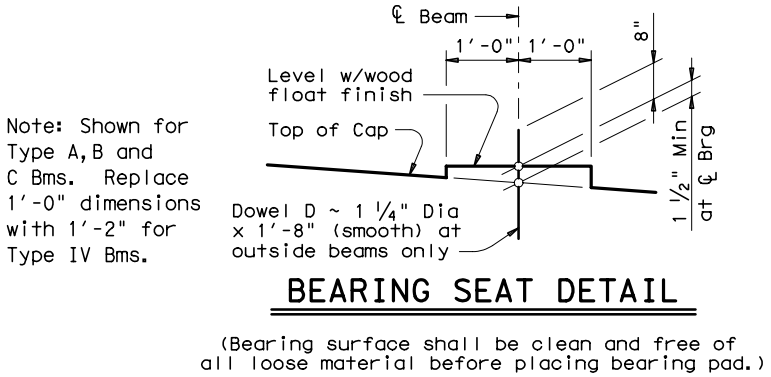


Figure 4-29: Standard Bearing Seat Elevation (with dowel condition) . Online users can click 4-29 to view this illustration in PDF.

Pedestal Bearing Seat Details

Bearing seat buildups over 3" are called pedestals and shall be reinforced as shown below. Each pedestal may vary slightly in placement of reinforcing depending on the type of beam, beam slope, shape of the pedestal, etc.

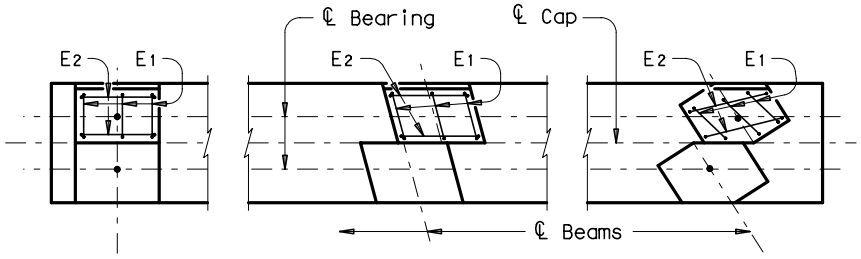


Figure 4-30: Typical Pedestal Bearing Seat Plan Views. Online users can click 4-30 to view this illustration in PDF.

Pedestal Section

Pedestal section and elevation details, similar to those shown below, shall also be included on the Interior Bent Sheet. Dowels D will be used at the ends of simple spans and at interior bents within multiple span units, but not at the ends of multiple span units.

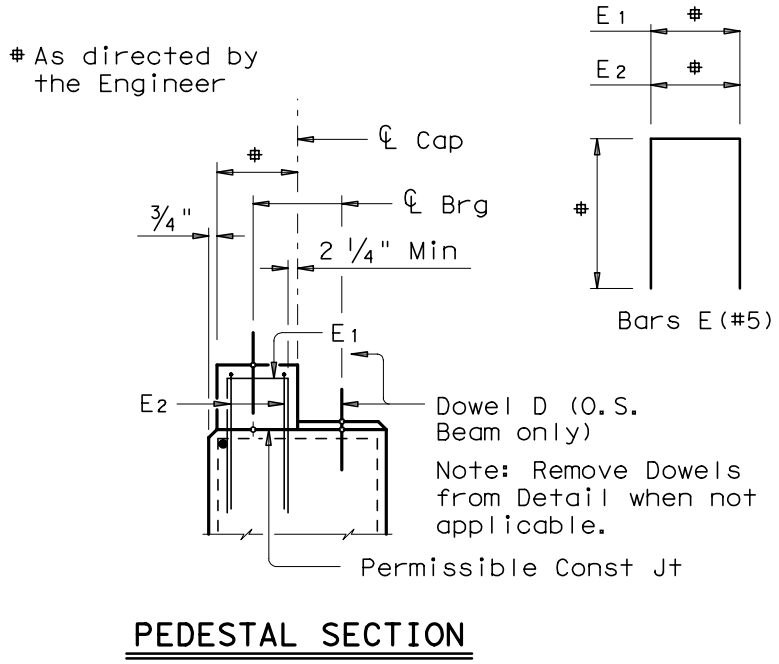


Figure 4-31: Pedestal Section. Online users can click 4-31 to view this illustration in PDF.

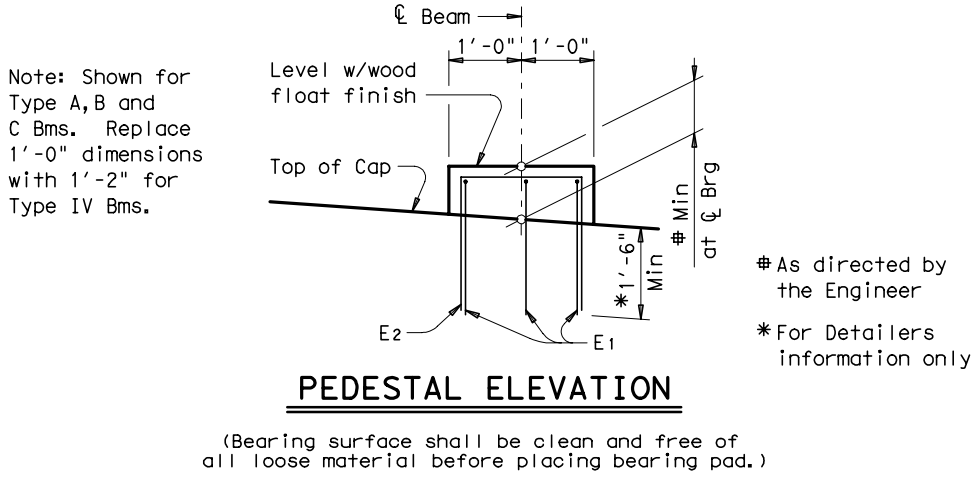


Figure 4-32: Pedestal Bearing Elevation (with no dowel condition) . Online users can click 4-32 to view this illustration in PDF.

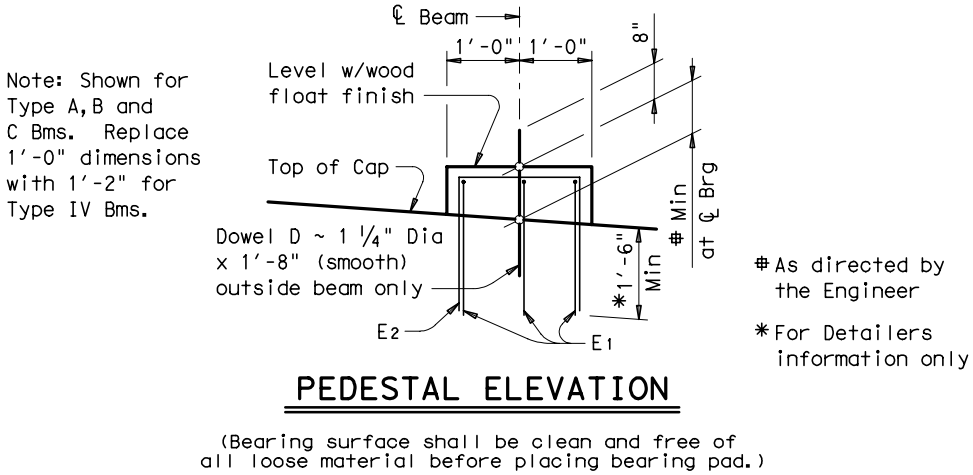


Figure 4-33: Pedestal Bearing Elevation (with dowel condition) . Online users can click 4-33 to view this illustration in PDF.

Waterproofing Details

A waterproofing detail shall be included on the Interior Bent Detail Sheet only when directed by the engineer. If included, the detail shall be similar to that shown below.

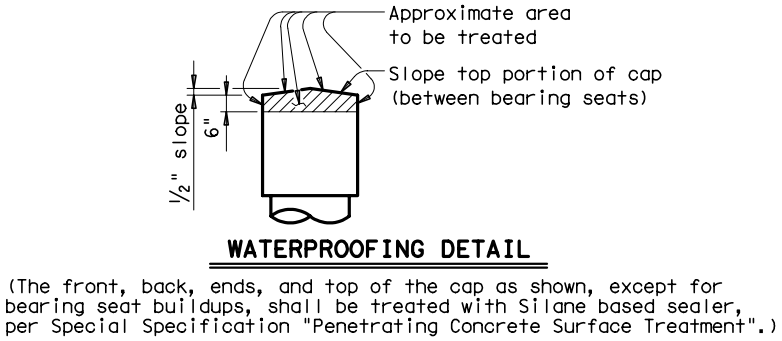


Figure 4-34: Typical Waterproofing Detail. Online users can click 4-34 to view this illustration in PDF.

Beam Hold-Down Detail

Place the following note on plans:

Beam hold-downs and shear keys shall be placed between the outside beam and first interior beam, upstream side of the structure at all bents.

The cost for furnishing and installing hold-down brackets shall be considered subsidiary to class "C" concrete.

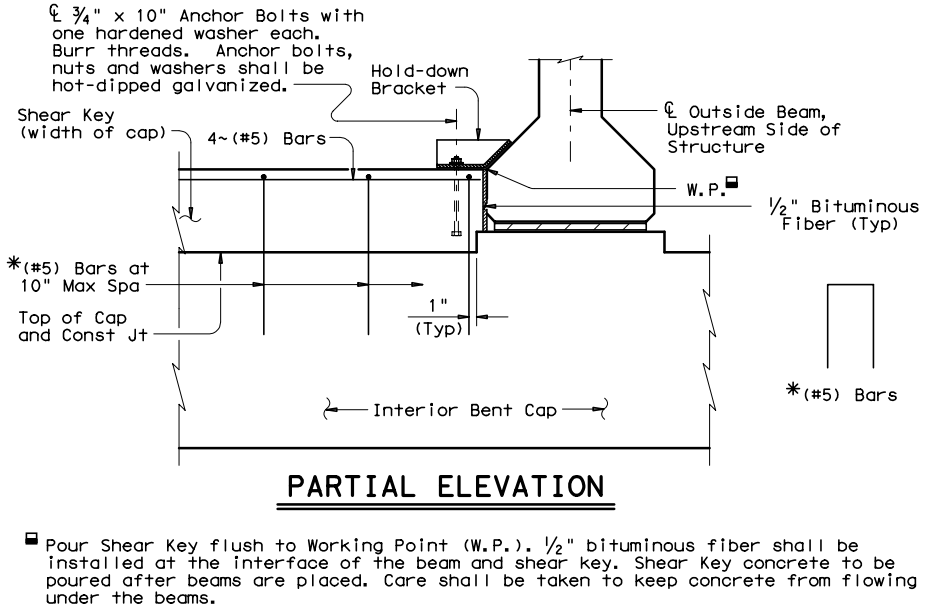


Figure 4-35: Beam Hold-Down Detail. Online users can click 4-35 to view this illustration in PDF.

Beam Hold-Down Bracket

NOTE: Hold-Down Brackets shall be hot-dipped galvanized after fabrication.

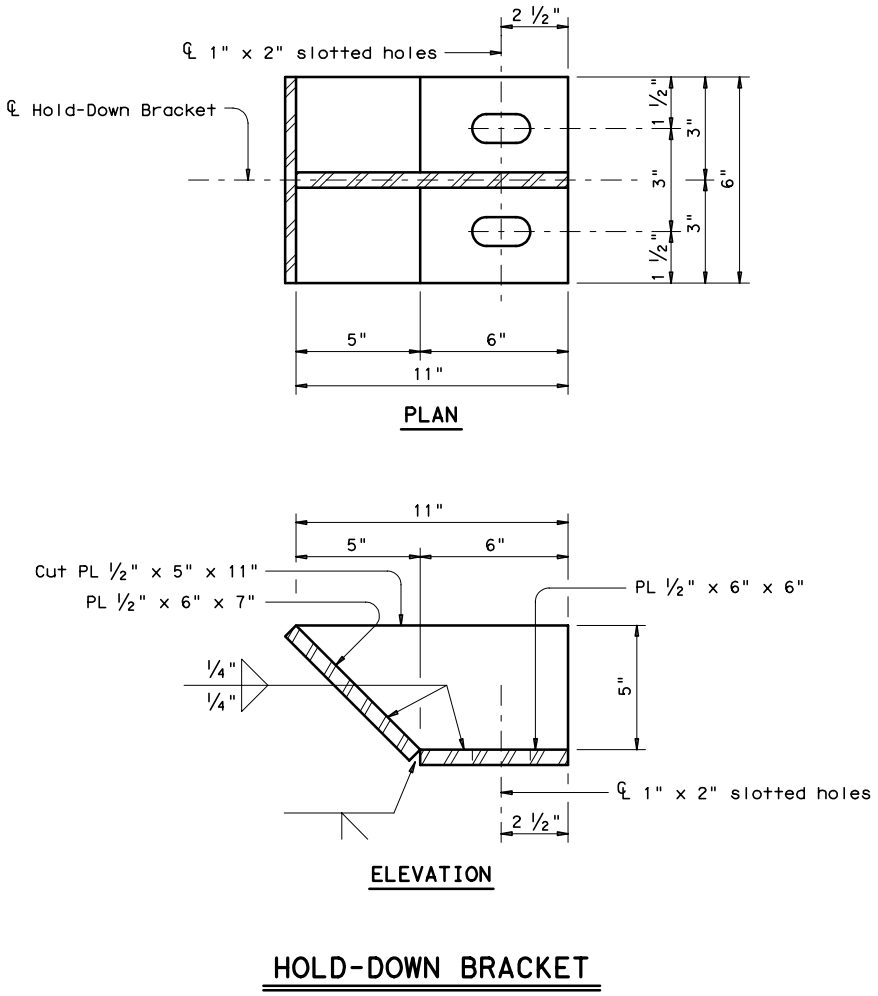


Figure 4-36: Beam Hold-Down Bracket. Online users can click 4-36 to view this illustration in PDF.

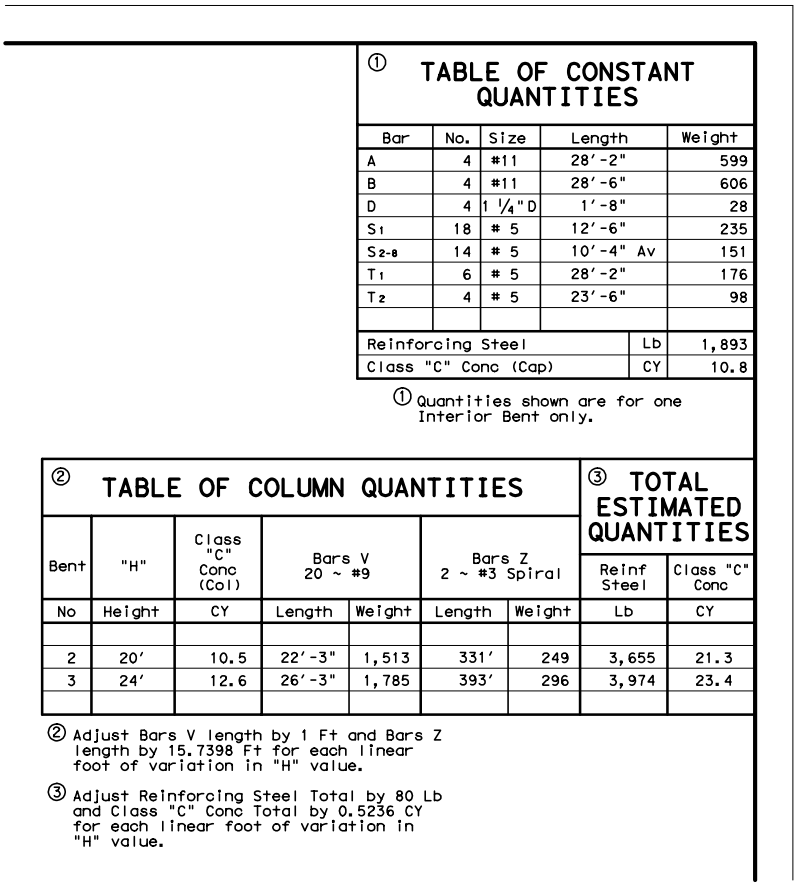
Table of Estimate Quantities

Tables of Estimated Quantities shall normally be shown on the plan view as detailed below. If the detail sheet is for more than one interior bent, a numbered note, as shown below, shall be included with the table.

Quantities shall be shown in the tables as listed below:

- Bar lengths - in feet and inches to the nearest inch
- Bar weights - in pounds to the nearest pound
- Concrete volume - in cubic yards to the nearest 0.1 cubic yard

Note that "H" heights are shown in even feet and display only the height as shown on the layout for each bent.



① TABLE OF CONSTANT QUANTITIES

Bar	No.	Size	Length	Weight
A	4	#11	28′-2"	599
B	4	#11	28′-6"	606
D	4	1 ¼"D	1′-8"	28
S_1	18	# 5	12′-6"	235
S_{2-8}	14	# 5	10′-4" Av	151
T_1	6	# 5	28′-2"	176
T_2	4	# 5	23′-6"	98
Reinforcing Steel			Lb	1,893
Class "C" Conc (Cap)			CY	10.8

① Quantities shown are for one Interior Bent only.

② TABLE OF COLUMN QUANTITIES

③ TOTAL ESTIMATED QUANTITIES

Bent	"H"	Class "C" Conc (Col)	Bars V 20 ~ #9		Bars Z 2 ~ #3 Spiral		Reinf Steel	Class "C" Conc
No	Height	CY	Length	Weight	Length	Weight	Lb	CY
2	20′	10.5	22′-3"	1,513	331′	249	3,655	21.3
3	24′	12.6	26′-3"	1,785	393′	296	3,974	23.4

② Adjust Bars V length by 1 Ft and Bars Z length by 15.7398 Ft for each linear foot of variation in "H" value.

③ Adjust Reinforcing Steel Total by 80 Lb and Class "C" Conc Total by 0.5236 CY for each linear foot of variation in "H" value.

Figure 4-37: Typical Tables of Estimated Quantities. Online users can click 4-37 to view this illustration in PDF.

General Notes, Title Block, and P.E. Seal

The general notes, title block, and engineer's seal shall normally be shown on the detail sheet in the format given below. Note that there will be considerable variation in the general notes between jobs, depending on structural needs. Particular care shall be taken to ensure that the loading criteria given are correct.

Whenever possible, space should be made available on the sheet to the immediate left of the title block for the engineer's seal.

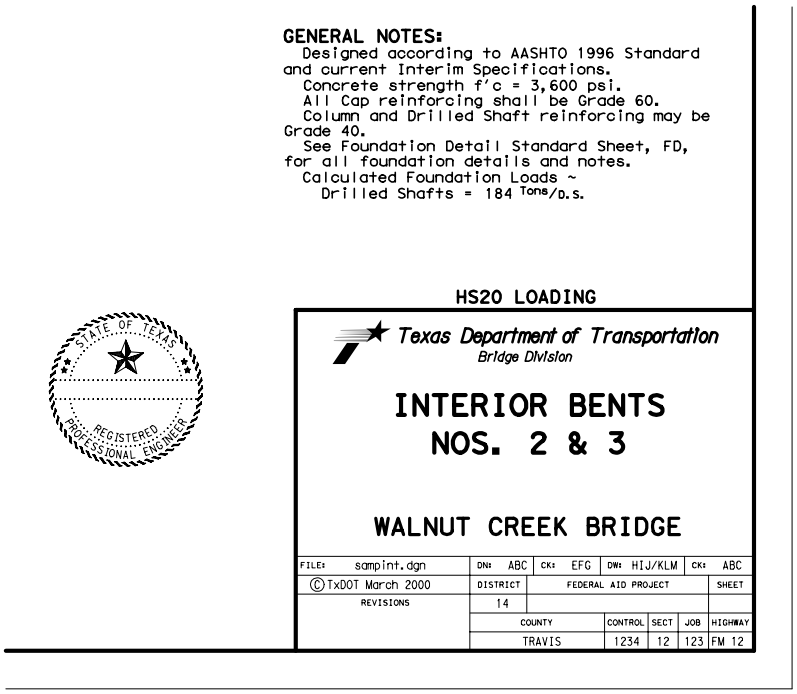


Figure 4-38: Typical General Notes, Title Block, and P.E. Seal. Online users can click 4-38 to view this illustration in PDF.

Chapter 5
Prestressed Concrete Beam Spans

Contents:

Section 1
General Information

Preferred Span or Multiple Span Unit Scales

The Prestressed Concrete Beam Span (or Multiple Span Unit) details sheet shall normally contain, but is not limited to, the following listed details (showing preferred scales):

Table 5-1: Span or Multiple Span Unit Scales

Details	Preferred Scale
Plan View	3/8" = 1'-0" or 1/4" = 1'-0" scale*
Typical Transverse Section	3/8" = 1'-0" or 1/2" = 1'-0" scale
Bar Details	3/8" = 1'-0" or 1/2" = 1'-0" scale
Dead Load Deflection Diagram	
Table of Estimated Quantities	
General Notes	
*Scale should be appropriate for the structure size. *NOTE:* The slab thickness on the Typical Transverse Section may be exaggerated for clarity.	

Dimensions shall normally be shown on the Prestressed Concrete Beam Span (or Unit) Details Sheet as listed below:

Structural dimensions and deflections. In the plan view, all structural dimensions in decimal feet to the nearest 0.001', except Controlled Joint or Construction Joint dimensions in feet and inches to the nearest 1/4". In the transverse section, all structural dimensions in feet and inches to the nearest 1/4", except beam spacing in decimal feet to the nearest 0.001'. Deflections shown in the dead load deflection diagram in decimal feet to the nearest 0.001'. All other views and details in feet and inches to the nearest 1/4".

Reinforcing steel. Rebar dimensions and locations in all views, including bar details, shall normally be in feet and inches to the nearest 1/4". All measurements are to the centerline of the rebars.

Cover. Cover for the top slab reinforcing is 2" clear cover and bottom slab reinforcing is 1 1/4" clear cover. Transverse bars have 1 1/2" end cover and longitudinal bars have 2" end cover.

Angles. In degrees, minutes, seconds to the nearest whole second, if such accuracy is available.

NOTE: For information about concrete slab and girder, box beam, U-beam, or double-T spans, use Bridge Division standards as examples.

Section 2
Prestressed Concrete Beam Span Sheets

Prestressed Concrete Beam Span Examples

These sheets are included to provide an example of the drafting layout of a typical Bridge Prestressed Concrete Beam Span (or Unit) Sheet. See the various sections of this chapter for directions on drawing particular details. Note that the plan view of a span is normally detailed with the direction of increasing stations to the right and the typical transverse section is shown facing the direction of increasing station.

Example – Skew 15º and Under

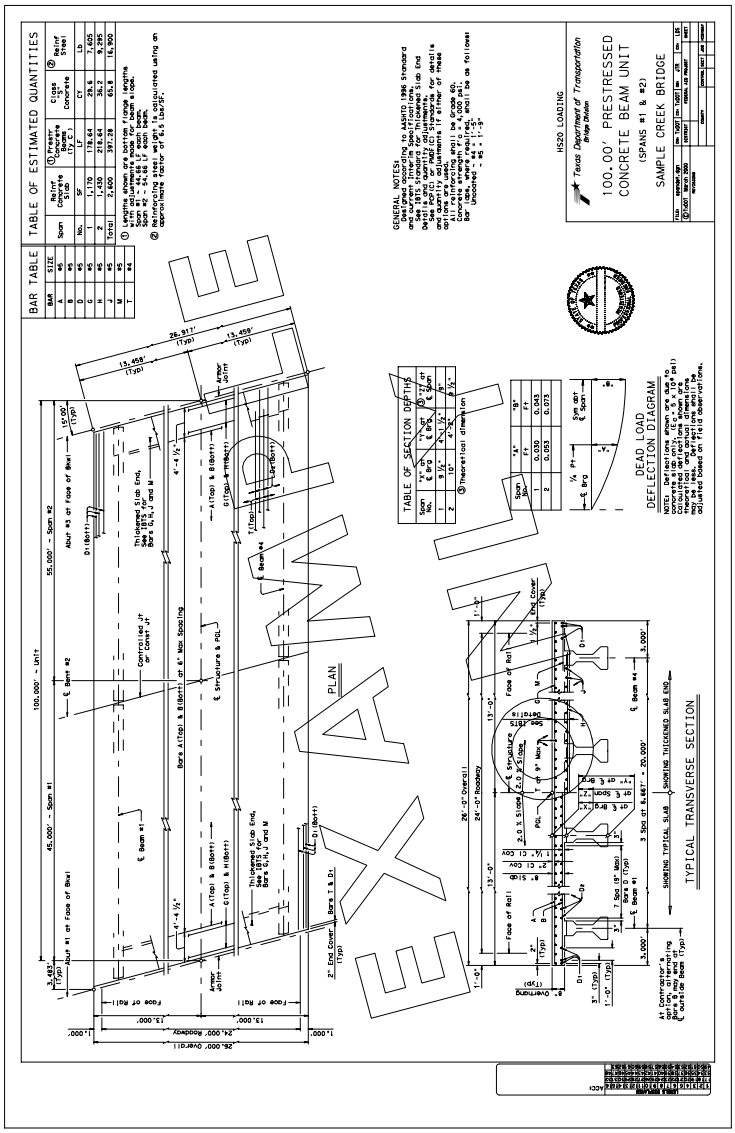


Figure 5-1: Example - Skew 15° and Under. Online users can click 5-1 to view this illustration in PDF.

Example – Skew Over 15º

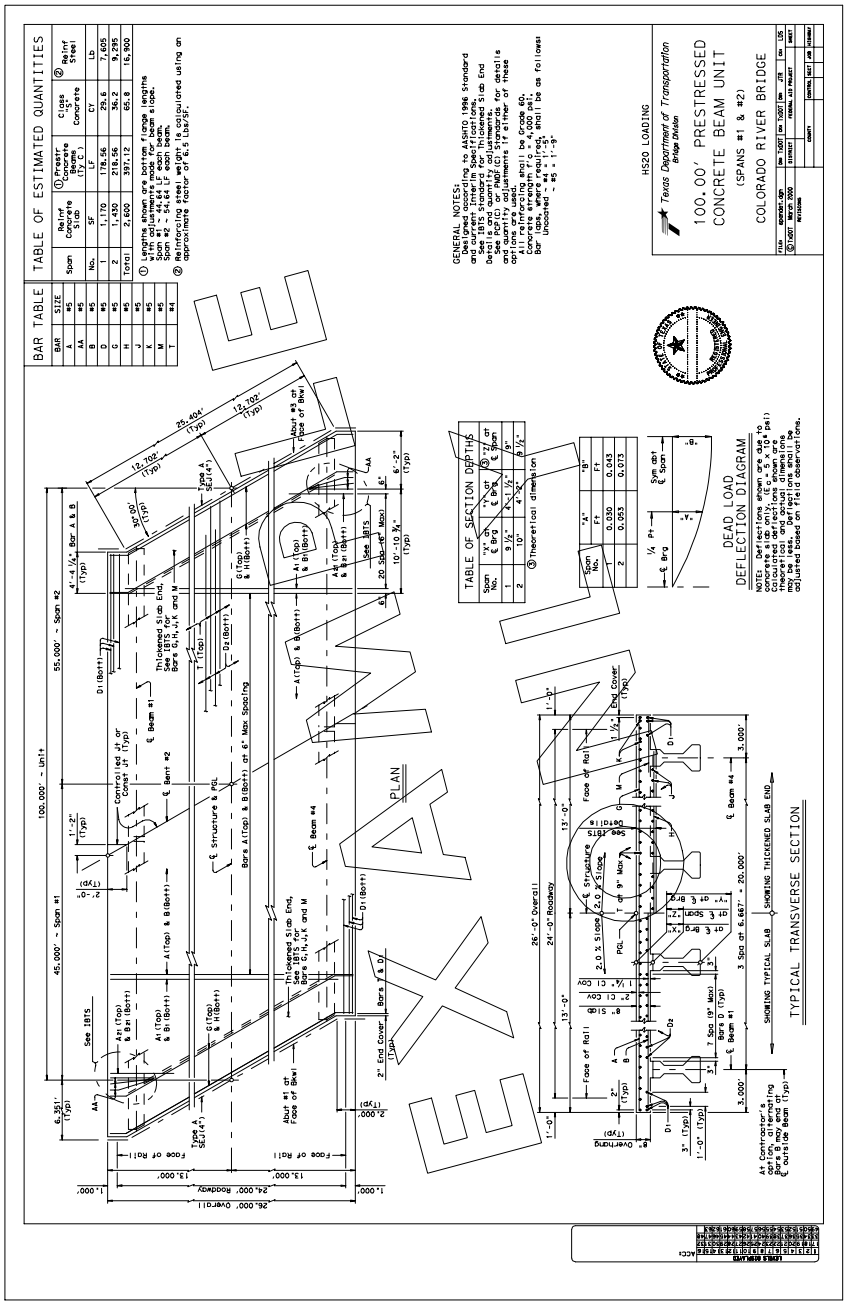


Figure 5-2: Example - Skew Over 15°. Online users can click 5-2 to view this illustration in PDF.

Example – Radial Slab

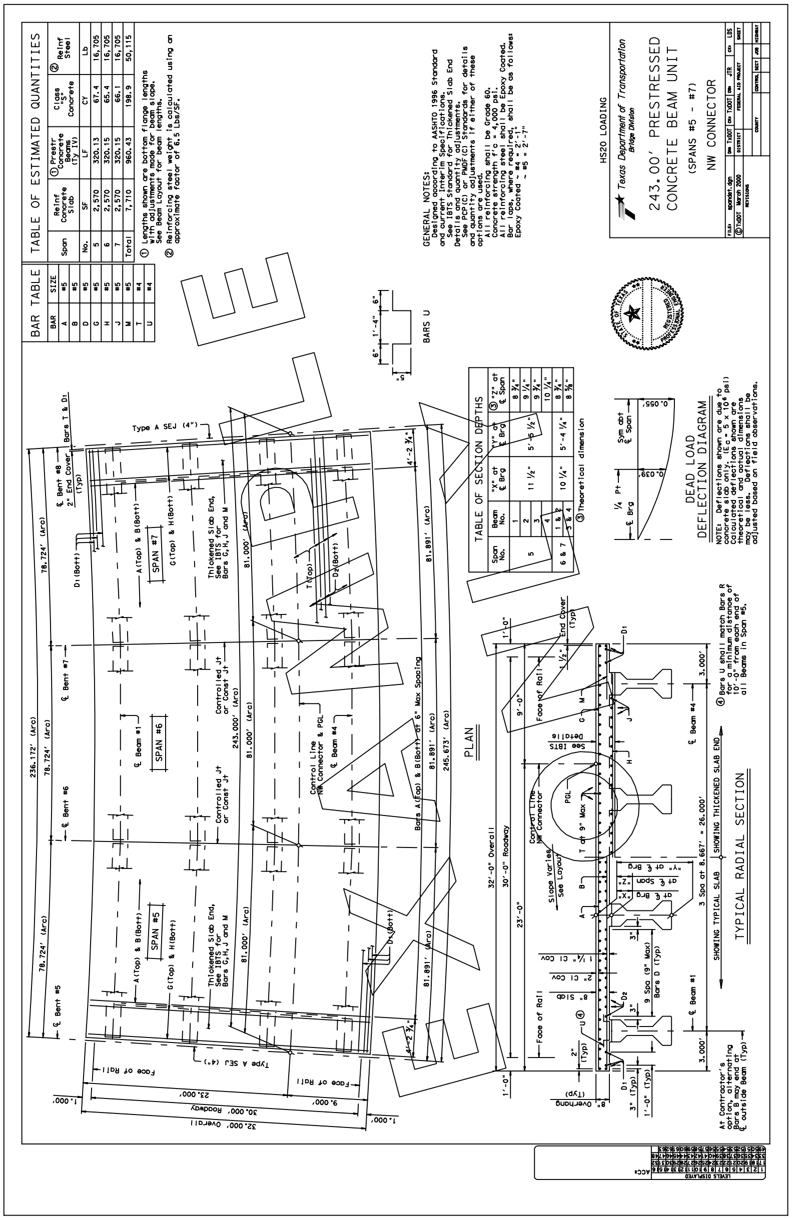


Figure 5-3: Example - Radial Slab. Online users can click 5-3 to view this illustration in PDF.

Example – Beam Layout

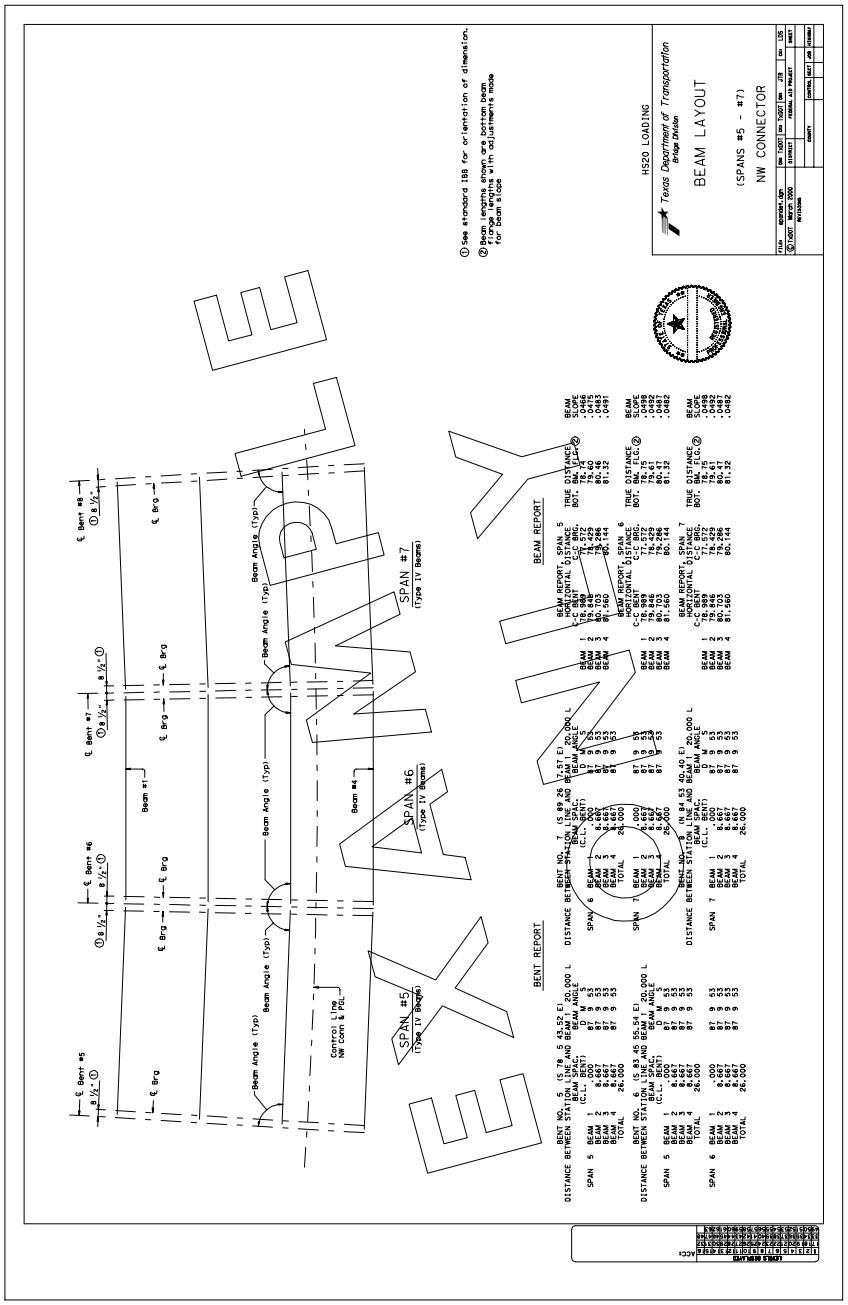


Figure 5-4: Example - Beam Layout. Online users can click 5-4 to view this illustration in PDF.

Section 3
Sheet Checklist

Plan View

Accurate, measurable detail, with exceptions to enhance clarity

1. ☐ Label and locate the control line at transverse and skewed ends of units, simple spans and spans within a multiple span unit if different (matching the terminology on the layout, such as reference line, centerline, or profile grade line).

2. ☐ Control dimensions shall be referenced to a working point (usually the intersection of the control line and the centerlines of bents and at the ends of the unit).

3. ☐ Overall unit length and individual span lengths dimensioned along the control line (and along slab edges if different)

4. ☐ Transverse widths of slab dimensioned, including overall, roadway, face of rail, curb, sidewalk and median widths, and working point locations at the beginning of the unit (and, if the unit contains variable width spans, at the ends of each span)

5. ☐ Dimension the 2.000' breakback on slabs with skews greater than 15°.

6. ☐ Outside beam lines located and numbered. Prestressed beam spans or units with varying beam angles, or varying beam lengths, or beam end conflicts will require beam layouts for only that portion(s) of the bridge in which they occur.

7. ☐ Skew angles (On structures with curved control lines, the angle is between a perpendicular and a tangent to the control line's horizontal curve at the working points at the ends of spans.)

8. ☐ Label joint locations (including construction joints or controlled joints, expansion joints, armor joints, etc.)

9. ☐ Slab reinforcing detailed, spacing dimensioned, and end cover shown

10. ☐ Thickened slab ends labeled and referenced to the standard sheet IBTS for reinforcing and construction details

11. ☐ Show abutment numbers and/or bent number.

Typical Transverse Section

Accurate, measurable detail, with exceptions to enhance clarity

1. ☐ Control line located both horizontally and vertically (note that more than one control line may be required)
2. ☐ Slab widths dimensioned (including overall, roadway, face of rail, offset from control line, etc.)
3. ☐ Reinforcing shown for typical slab section and for thickened slab end
4. ☐ Reinforcing cover and slab thickness (interior and overhang)
5. ☐ Section depths (using table if required)
6. ☐ Beam spacing and identification
7. ☐ Crown or roadway slope
8. ☐ Spacing for bars T and D
9. ☐ Overlay information (if required)

Other Details

Accurate, measurable details, with exceptions to enhance clarity

1. ☐ Bar details, if applicable
2. ☐ Joint details, if applicable
3. ☐ Dead load deflection diagram
4. ☐ Tables of quantities
5. ☐ General notes (including, but not limited to, design criteria, loading, class of concrete, epoxy coating, and cross references to various standard sheets)
6. ☐ Title block, information block, and engineer's seal

Final Checks

1. ☐ Check all details and dimensions against substructure to ensure the details are not in conflict.
2. ☐ Double check bars in various details against the bars shown in the bar table.
3. ☐ Make sure that bridge drains and/or bridge lighting brackets are located correctly on the layout, when applicable.
4. ☐ Ensure that the name of the bridge is same on all detail sheets (including layout).
5. ☐ Initial the sheet after back-checking corrected details.

Section 4
Normal Parameters

Prestressed Concrete Beam Span Parameters

Normal prestressed concrete beam span parameters are as follows:

- 8" - normal (preferred) slab thickness*
- 8" - overhang thickness for all slabs 8" and under
- 9'-0" - normal maximum beam spacing
- 9'-6" - maximum beam spacing for flared beams
- 1'-0" - normal nominal face of rail to edge of slab (some bridge types may have greater than 1'-0")
- 3'-0" - normal edge of slab to centerline of beam

*7 3/4" or 7 1/2" slab thickness may be considered (See Bridge Design Manual)

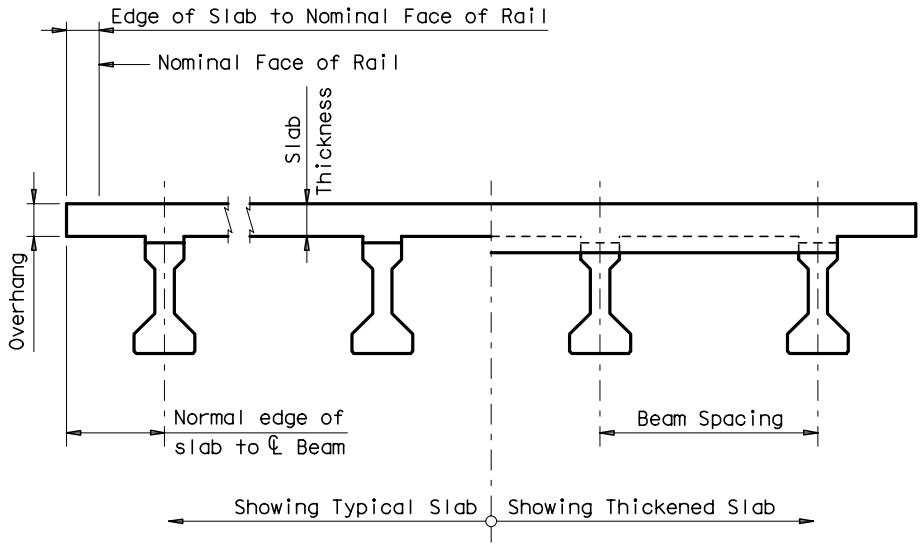
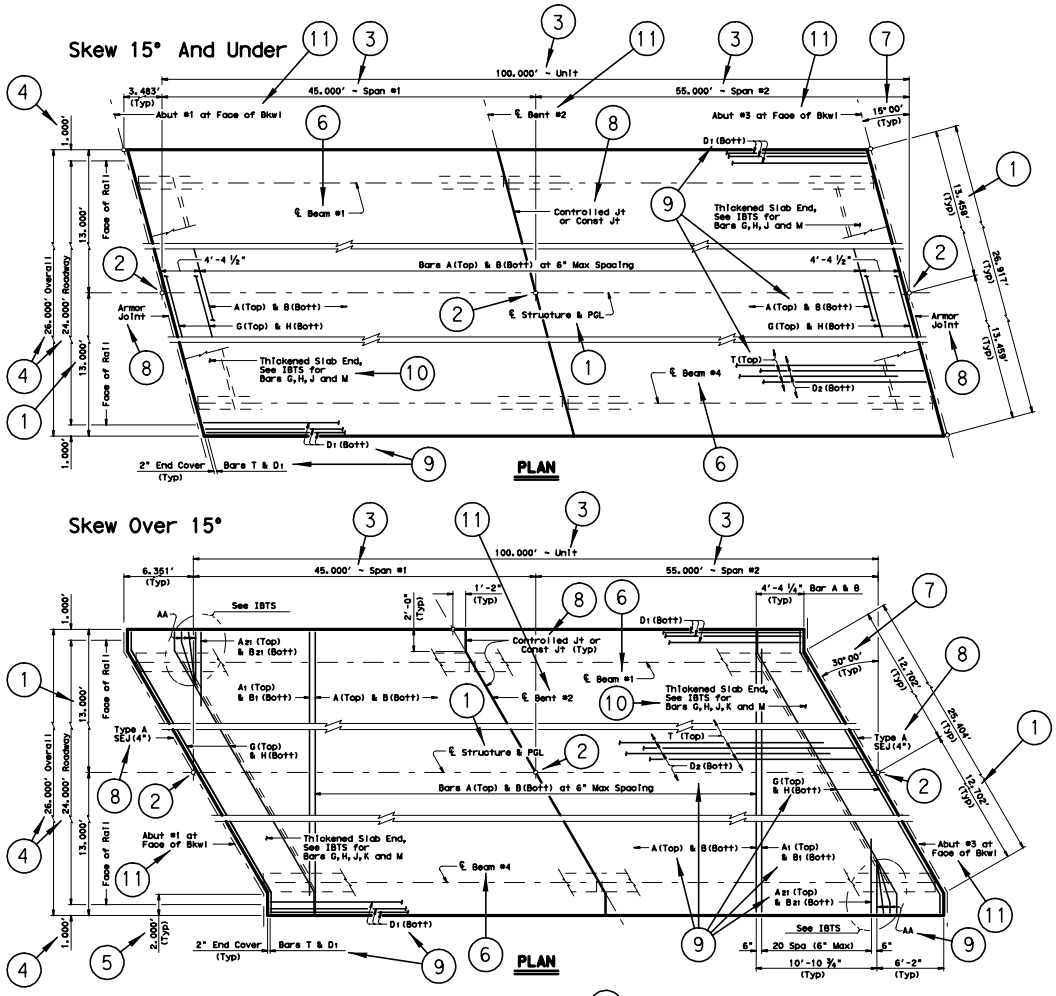


Figure 5-5: Typical Transverse Section. Online users can click 5-5 to view this illustration in PDF.

Section 5
Prestressed I-Beam Spans

Plan View Example

The plan view checklist , presented in Section 3, should be followed to ensure that the details are accurate and complete.



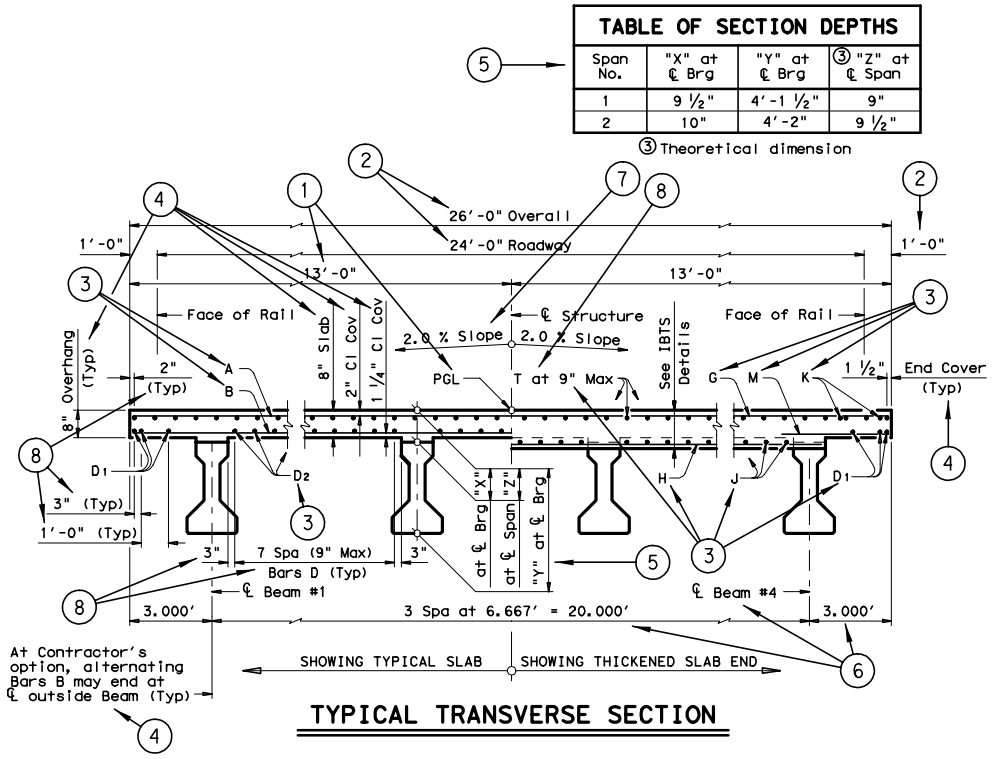
(1)	Control line and location	(6)	Outside beam and beam number
(2)	Working point	(7)	Skew angles
(3)	Overall dimensioning	(8)	Joint type
(4)	Transverse dimensioning	(9)	Slab reinforcing
(5)	2.000' breakback	(10)	Thickened slab end
		(11)	Abutment and/or Bent Number

Figure 5-6: Plan View, Checklist Items. Online users can click 5-6 to view this illustration in PDF.

Typical Transverse Section Example

The transverse section will generally be shown facing increasing stations. Structural dimensions shown shall be given in feet and inches to the nearest 1/4". Beam spacing shall be given in decimal feet to the nearest 0.001'. For thickened slab ends see IBTS standard. Bars K are needed only when skews are greater than 15°.

NOTE: Maximum spacing of bars D and T is always measured at the wide end of a flared span.

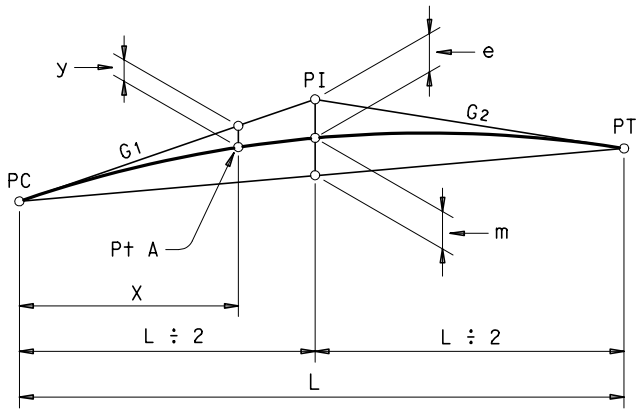


1. Control line and location
2. Slab widths dimensioned
3. Reinforcing for Typical Slab and Thickened Slab End
4. Reinforcing clear cover, end cover, overhang and slab thickness dimensions
5. Section depths (using table if required)
6. Beam spacing and identification
7. Crown or roadway slope
8. Spacing for Bars T and D

Figure 5-7: Typical Transverse Section, Checklist Items. Online users can click 5-7 to view this illustration in PDF.

Section 6
Curve Information

Vertical Curve



L = length of Vertical parabolic curve PC-PT measured along the horizontal projection (Station change)

PI = point of intersection

PC = point of curvature

PT = point of tangency

m = mid-ordinate (m = e)

G_1 & G_2 = tangent grades ($G_1 \neq G_2$)

$$m = e = (L) \left(\frac{G_1 - G_2}{8}\right)$$

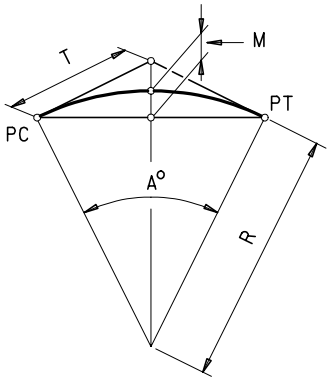
$$y = F X^2 = \frac{X^2 m}{(L \div 2)^2}$$

$$F = \frac{m}{(L \div 2)^2} = \frac{(G_1 - G_2) L}{8 (L \div 2)^2} = \frac{G_1 - G_2}{2 L}$$

Elevation at Pt A = PC elev + (G_1 X) - (F X^2)

Figure 5-8: Vertical Curve. Online users can click 5-8 to view this illustration in PDF.

Horizontal Curve



L = length of circular arc PC-PT (Sta change)

R = radius

D° = degree of curve

A° = central angle

M = mid-ordinate

LC = length of chord PC-PT

T = tangent length

$$R \text{ (arc definition)} = \frac{(180)\ (100')\ \div\ \pi}{D^\circ} = \frac{5729.5780}{D^\circ}$$

$$T = R\ \text{Tan}\ (\tfrac{1}{2}\ A^\circ)$$

$$L = \frac{(100')\ A^\circ}{D^\circ} = \frac{(100')\ R\ A^\circ}{5729.5780} = 0.01745329\ R\ A^\circ$$

$$LC = 2\ R\ \text{Sin}\ (\tfrac{1}{2}\ A^\circ)$$

$$M = R\ [\ 1 - \text{Cos}\ (\tfrac{1}{2}\ A^\circ)\ ]$$

TxDOT uses Arc Definition to establish a horizontal curve.

For example:
a given degree of curve of 6° 15", then

$R = (\ 5729.5780\ ) \div (\ 6.25^\circ\ )$
$= 916.7325'$ Radius

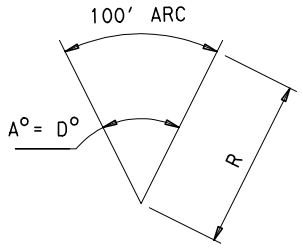


Figure 5-9: Horizontal Curve. Online users can click 5-9 to view this illustration in PDF.

Section 7
Miscellaneous Slab Information

Structural Dimensions

Plan view of a prestressed concrete beam slab or unit shall be shown with increasing stations to the right.

Structural dimensions shall be shown, in decimal feet to the nearest 0.001', for each span or spans within a unit.

First and last beam should always be shown on the plan view of a prestressed concrete beam span or in each span within a unit.

When a prestressed concrete beam unit has more than one beam type, the beam type and beam number shall be shown in the plan view of each span within a unit. Complicated beam information should be shown on a separate Beam Layout Sheet.

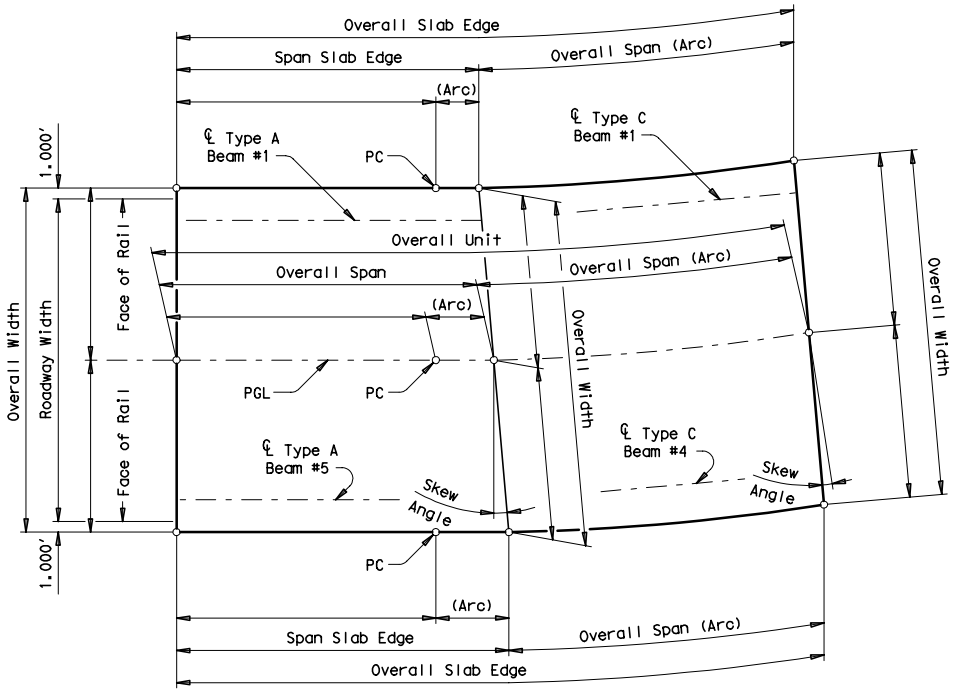


Figure 5-10: Structural Dimensions. Online users can click 5-10 to view this illustration in PDF.

Example RDS Report

The Roadway Design System (RDS) program aids in the geometric design of bridges

```
                    TEXAS STATE DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION        COMMON V 7.1.9

                                    ROADWAY DESIGN SYSTEM                  *** BRIDGE GEOMETRICS ***
EXAMPLE PROBLEM                                                                          MARCH 18, 1999
CONTROL 1234 SECTION 56A                                          COUNTY + HIGHWAY - EXAMPLE PROBLEM

SLAB     2    3    1    2  3  4        8.0000    8.0000                          B B
                                          SLAB REPORT

                                            SPAN 2

                          SEG.  SEGMENT      SEGMENT        CHORD      RADIUS     ACCUMULATED  DISTANCE
                          NO.   LENGTH       OR CHORD       LENGTH                SEGMENT      TO RADIAL
                                             BEARING                              LENGTHS      INTERSECT
LEFT EDGE     (PSLB 1)    1     13.5314   N 72 20 49.96 E   13.5314      0.0000    13.5314
                          2     66.2786   N 73 39 19.15 E   66.2729  -1451.5195    79.8100      18.7854
RIGHT EDGE    (PSLB 2)    1     80.2104   N 74 10 49.88 E   80.1997  -1413.2695    80.2104      59.4165

                          SEG.  SEGMENT      SEGMENT            SKEW       DISTANCE TO     RADIAL
                          NO.   LENGTH       BEARING            ANGLE      STATION LINE    DISTANCE

                          1      2.0000   N 17 39 10.04 W
BACK EDGE     (BENT 2)    2     39.0087   N 46 13 15.82 W    28 34  5.79      19.4990       36.2500
                          3      2.0000   N 17 26 43.43 W

                          1      2.0000   N 15  2 11.66 W
FORWARD EDGE  (BENT 3)    2     40.2139   N 46 13 15.82 W    31 36  0.00      20.0615       36.2500
                          3      2.0000   N 14 11 36.82 W

SLAB DEPTH = 8.0000 IN., OVERHANG DEPTH = 8.0000 IN.
SLAB AREA = 3060.3195 SQ. FT. = 340.0355 SQ. YDS.
```

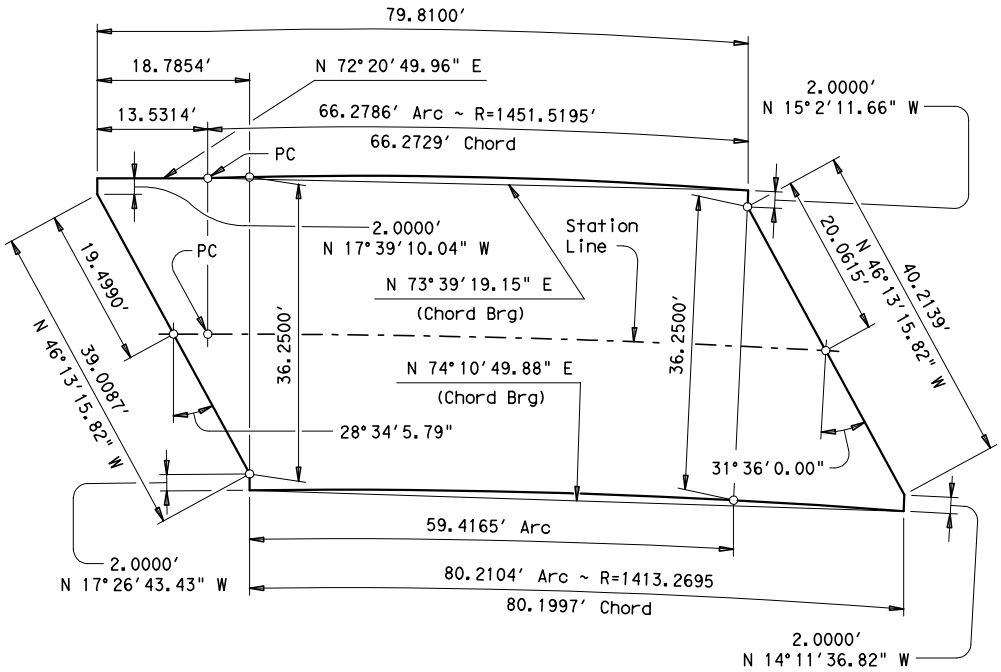


Figure 5-11: Example of RDS Report. Online users can click 5-11 to view this illustration in PDF.

Beam Layout Report

Prestressed beam spans or units with varying beam angles or varying beam lengths or beam end conflicts will require beam layouts for only that portion(s) of the bridge in which they occur. The beam layout shall be shown with increasing stations to the right. Dimensions shall be in decimal feet to the nearest 0.001', except for centerline bent to centerline bearing dimensions, which are shown in feet and inches.

NOTE: Bent and beam reports shown on beam layouts come directly from the RDS program.

BENT REPORT

BENT NO. 5 (S 78 5 43.52 E)
DISTANCE BETWEEN STATION LINE AND BEAM 1 20.000 L

		BEAM SPAC. (C.L. BENT)	BEAM ANGLE D M S
SPAN 5	BEAM 1	.000	87 9 53
	BEAM 2	8.667	87 9 53
	BEAM 3	8.667	87 9 53
	BEAM 4	8.667	87 9 53
	TOTAL	26.000	

BENT NO. 6 (S 83 45 55.54 E)
DISTANCE BETWEEN STATION LINE AND BEAM 1 20.000 L

		BEAM SPAC. (C.L. BENT)	BEAM ANGLE D M S
SPAN 5	BEAM 1	.000	87 9 53
	BEAM 2	8.667	87 9 53
	BEAM 3	8.667	87 9 53
	BEAM 4	8.667	87 9 53
	TOTAL	26.000	
SPAN 6	BEAM 1	.000	87 9 53
	BEAM 2	8.667	87 9 53
	BEAM 3	8.667	87 9 53
	BEAM 4	8.667	87 9 53
	TOTAL	26.000	

BENT NO. 7 (S 89 26 7.57 E)
DISTANCE BETWEEN STATION LINE AND BEAM 1 20.000 L

		BEAM SPAC. (C.L. BENT)	BEAM ANGLE D M S
SPAN 6	BEAM 1	.000	87 9 53
	BEAM 2	8.667	87 9 53
	BEAM 3	8.667	87 9 53
	BEAM 4	8.667	87 9 53
	TOTAL	26.000	
SPAN 7	BEAM 1	.000	87 9 53
	BEAM 2	8.667	87 9 53
	BEAM 3	8.667	87 9 53
	BEAM 4	8.667	87 9 53
	TOTAL	26.000	

BENT NO. 8 (N 84 53 40.40 E)
DISTANCE BETWEEN STATION LINE AND BEAM 1 20.000 L

		BEAM SPAC. (C.L. BENT)	BEAM ANGLE D M S
SPAN 7	BEAM 1	.000	87 9 53
	BEAM 2	8.667	87 9 53
	BEAM 3	8.667	87 9 53
	BEAM 4	8.667	87 9 53
	TOTAL	26.000	

BEAM REPORT

BEAM REPORT, SPAN 5

	HORIZONTAL DISTANCE C-C BENT	C-C BRG.	TRUE DISTANCE BOT. BM. FLG. ②	BEAM SLOPE
BEAM 1	78.989	77.572	78.74	.0466
BEAM 2	79.846	78.429	79.60	.0475
BEAM 3	80.703	79.286	80.46	.0483
BEAM 4	81.560	80.144	81.32	.0491

BEAM REPORT, SPAN 6

	HORIZONTAL DISTANCE C-C BENT	C-C BRG.	TRUE DISTANCE BOT. BM. FLG. ②	BEAM SLOPE
BEAM 1	78.989	77.572	78.75	.0498
BEAM 2	79.846	78.429	79.61	.0492
BEAM 3	80.703	79.286	80.47	.0487
BEAM 4	81.560	80.144	81.32	.0482

BEAM REPORT, SPAN 7

	HORIZONTAL DISTANCE C-C BENT	C-C BRG.	TRUE DISTANCE BOT. BM. FLG. ②	BEAM SLOPE
BEAM 1	78.989	77.572	78.75	.0498
BEAM 2	79.846	78.429	79.61	.0492
BEAM 3	80.703	79.286	80.47	.0487
BEAM 4	81.560	80.144	81.32	.0482

② Beam lengths shown are bottom beam flange lengths with adjustments made for beam slope

Figure 5-12: Beam Layout Report. Online users can click 5-12 to view this illustration in PDF.

Controlled or Construction Joint

A multi-span unit will have a controlled joint or construction joint at centerline of bent(s) within a unit. On skews greater than 15° the controlled joint or construction joint ends shall be dimensioned 2'-0" perpendicular to the edge of slab. The 2'-0" dimension shall be located and dimensioned along the outside edge of slab to the intersection of centerline of bent. See example below.

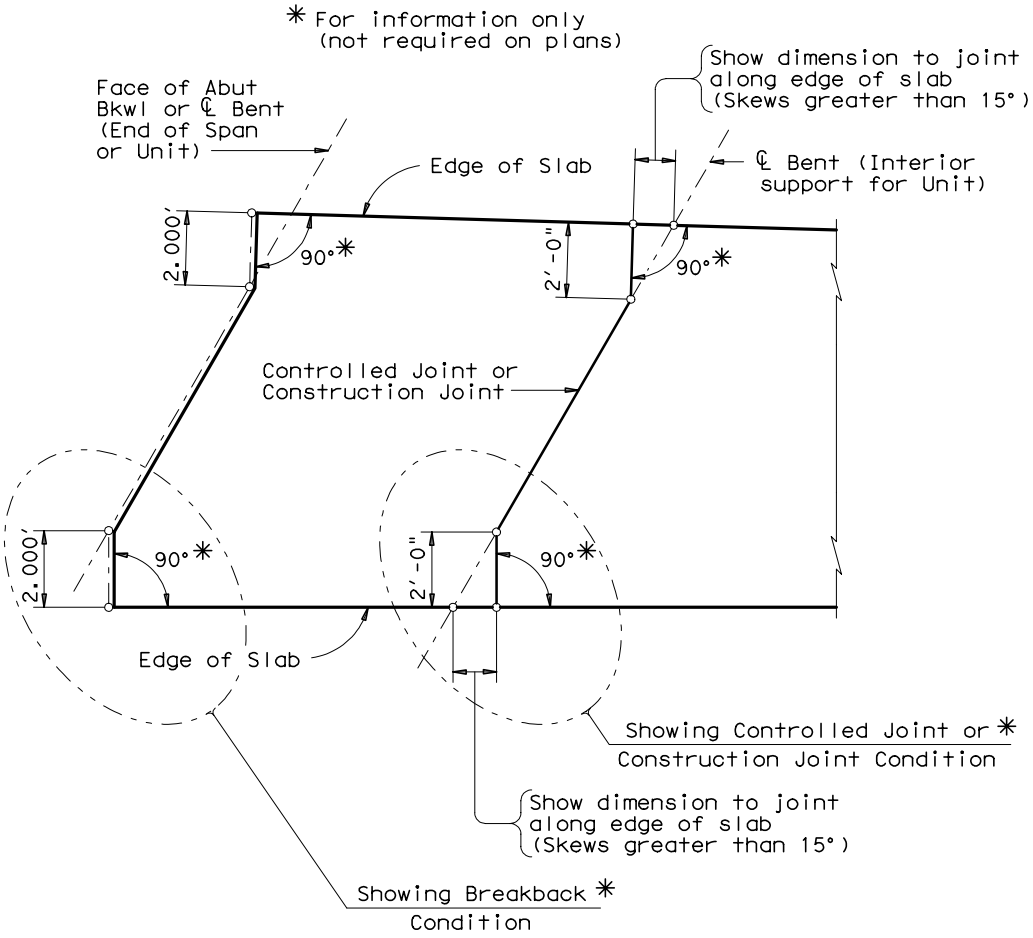


Figure 5-13: Controlled or Construction Joint. Online users can click 5-13 to view this illustration in PDF.

Changes in Beam Spacing and/or Slab Thickness in a Unit

When a change in beam spacing occurs within a prestressed concrete beam unit, the embedment lap for the D_2 bars can occur on either side of the centerline of bent.

With a transition of different slab thicknesses within a prestressed concrete beam unit, the embedment lap for the D_2 bar will occur in the thickest slab.

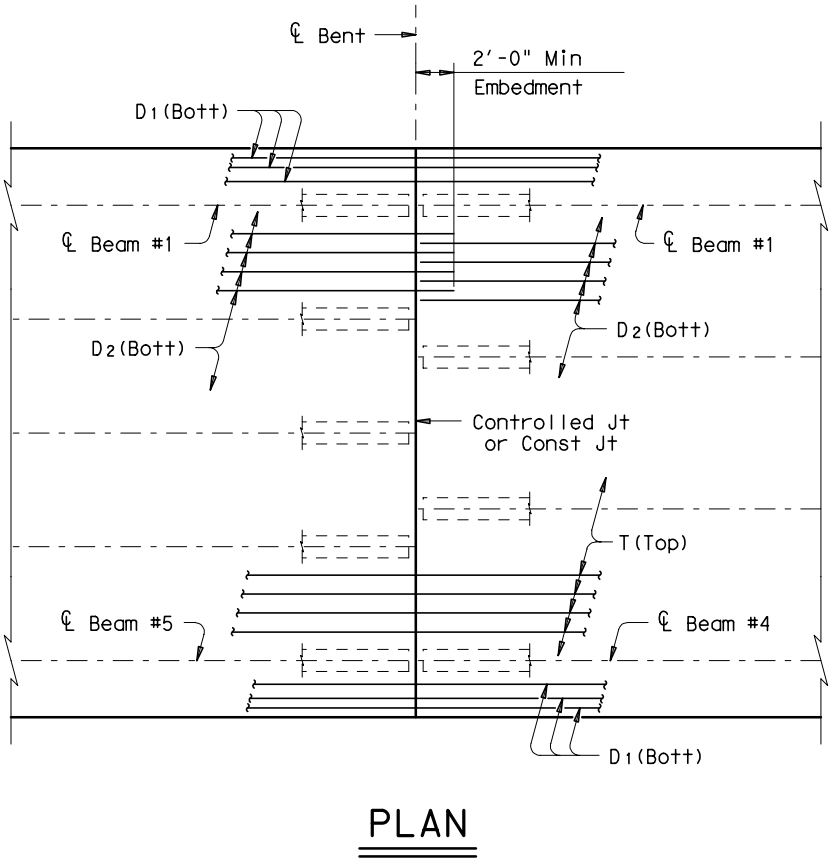
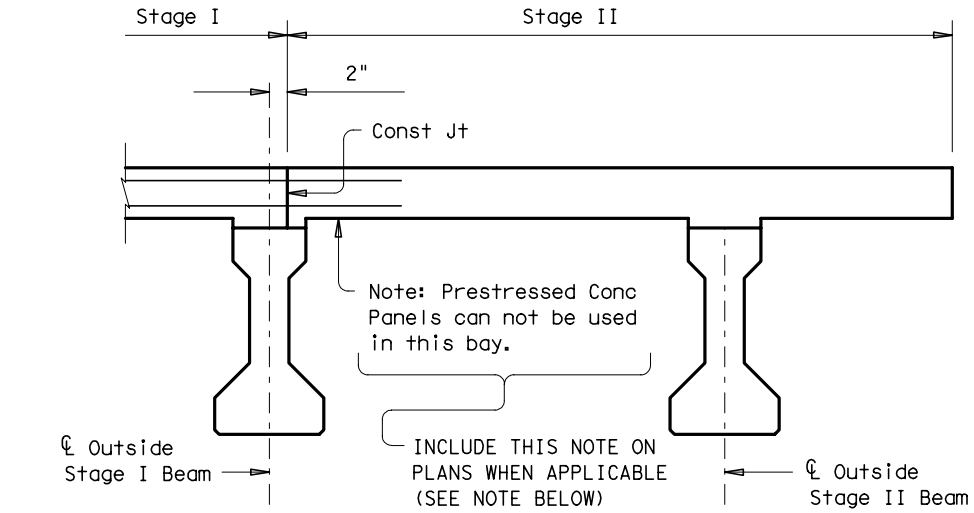


Figure 5-14: Changes in Beam Spacing and/or Slab Thickness in a Unit. Online users can click 5-14 to view this illustration in PDF.



Note: Prestressed Concrete Panels may be used only when the Construction Joint is at Centerline of Beam. See Bridge Design Manual for more information about Staged Construction.

Figure 5-15: Stage (or Phased) New Construction. Online users can click 5-15 to view this illustration in PDF.

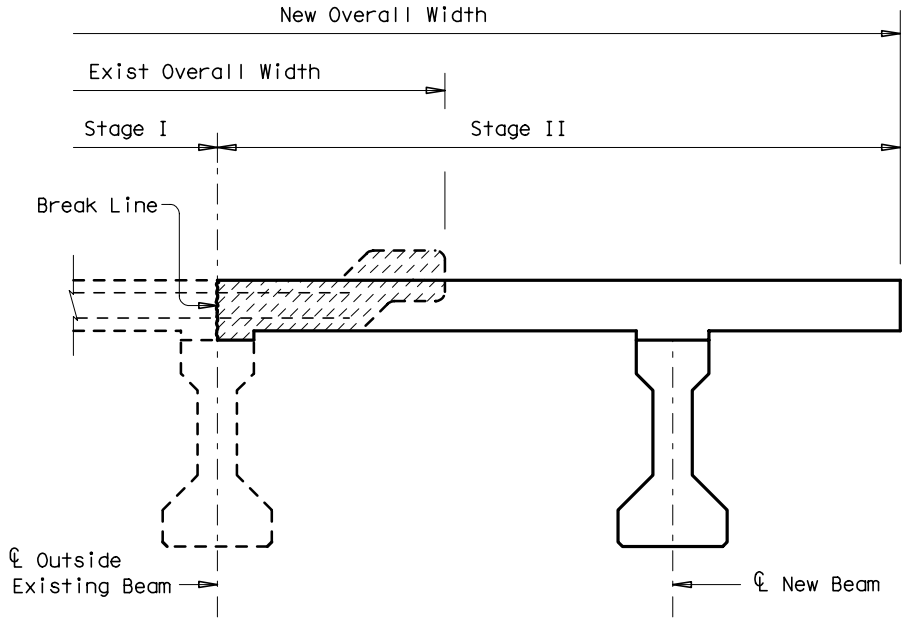


Figure 5-16: Widenings (Stage or Non-Staged) . Online users can click 5-16 to view this illustration in PDF.

Section 8
Beam Haunch

Beam Haunch Details

The purpose of a beam haunch is to absorb the beam camber without intrusion of the beam into the bottom of the slab at centerline of bearing or at mid-span. This allows us to maintain a uniform slab thickness. We use 1/2" minimum at the edge of the beam at mid-span to accommodate the bedding strips for prestressed concrete panels. Regardless of calculated value, the absolute minimum haunch at centerline of bearing shall be 1". (increase in 1/4" increments).

If the height of the beam haunch concrete is greater than 3", the haunch concrete must be reinforced. Normal haunch reinforcing is shown below.

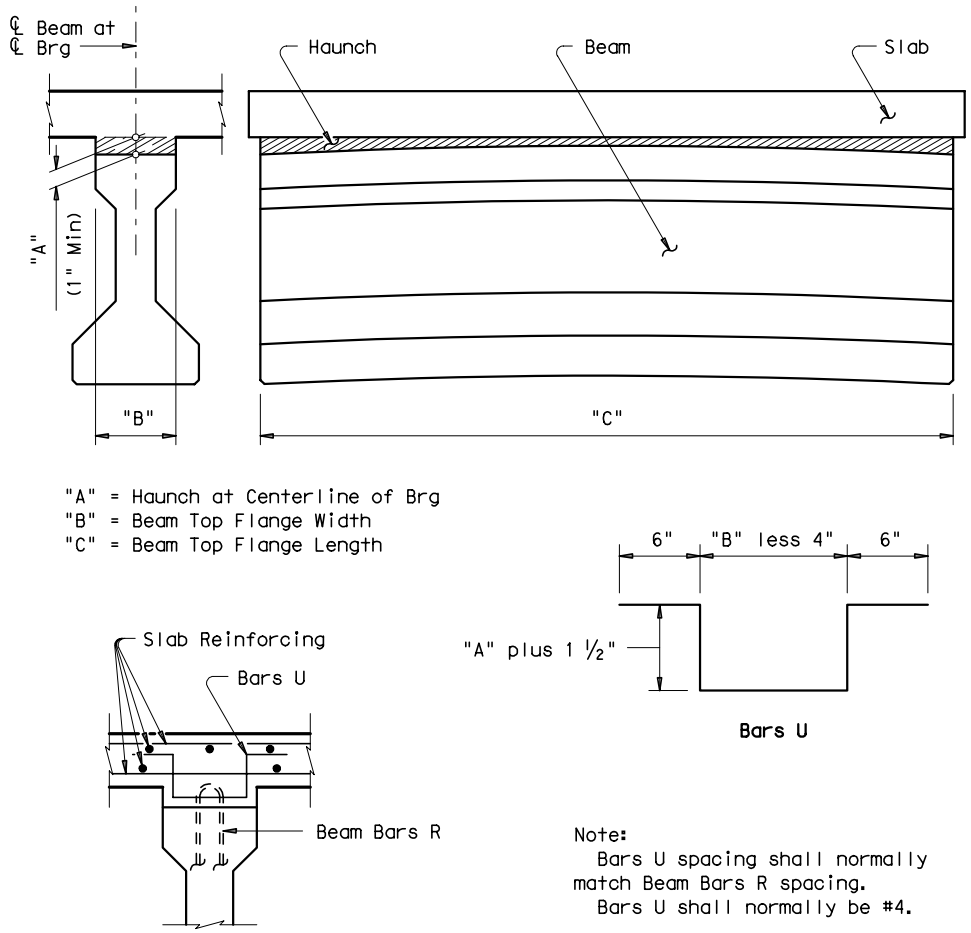


Figure 5-17: Beam Haunch Details. Online users can click 5-17 to view this illustration in PDF.

Section 9
Typical Reinforcing

Typical Bar Sizes for Spans or Multiple Span Units

The information in this section shows typical prestressed concrete beam span slab reinforcing and its placement. The rebar sizes, bends, and locations may, however, be different from that given due to design requirements.

Prestressed concrete beam span slab reinforcing default sizes are as follows:

Table 5-2: Typical Bar Sizes

Reinforcing Bars	Default Size
Bars A, B & D	#5
Bars AA, G, H, J, K & M	#5*
Bars T	#4
Bars U	#4 (See Beam Haunch Details)
* Thickened slab end bars that are detailed on the IBTS standard. These bars referenced on the prestressed concrete beam spans or units and shown in the bar table.	

Details that do not need to be shown on the plan sheet are constant length straight bars unless the bars are lap spliced and the location of the lap is significant (such as occurs on staged construction).

The maximum length of rebar, without a bar lap, is 60 feet.

Typical Plan Reinforcing

Transverse slab reinforcing shall normally be dimensioned on the plan view in feet and inches. End cover for transverse reinforcing shall be shown on the typical transverse or radial section. The transverse reinforcing is bars A and B. Longitudinal slab reinforcing is normally shown on the plan view for reference. Typical longitudinal reinforcing is bars T, D_1, and D_2. Bars D_2 shall end 3'-0" from end of slab or unit with thickened slab ends. See IBTS standard for details.

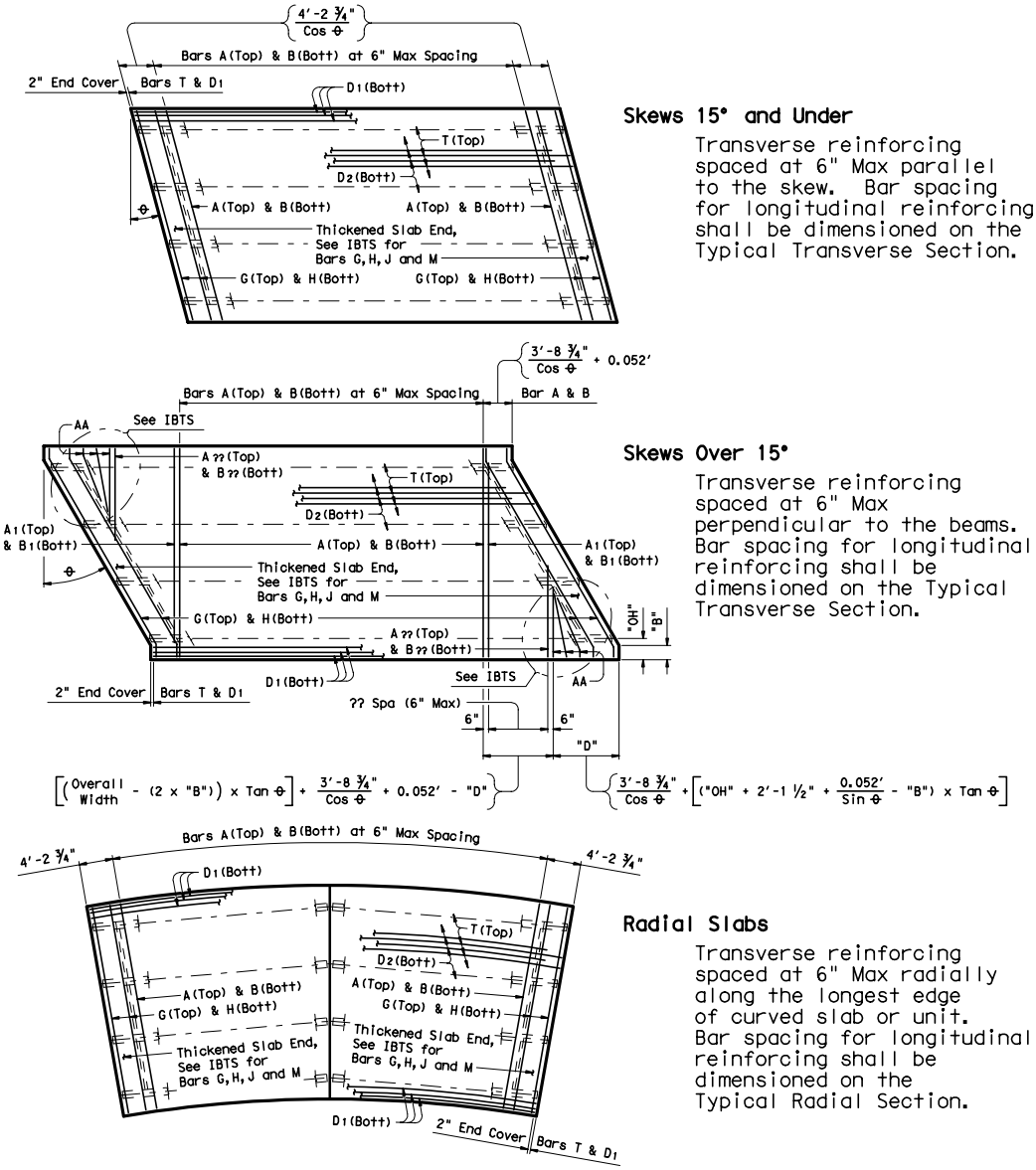


Figure 5-18: Typical Plan Reinforcing. Online users can click 5-18 to view this illustration in PDF.

Typical Transverse Section Reinforcing

For thickened slab end information, see IBTS standard.

NOTE: Maximum spacing for bars D and T is always measured at the wide end of a flared span or unit.

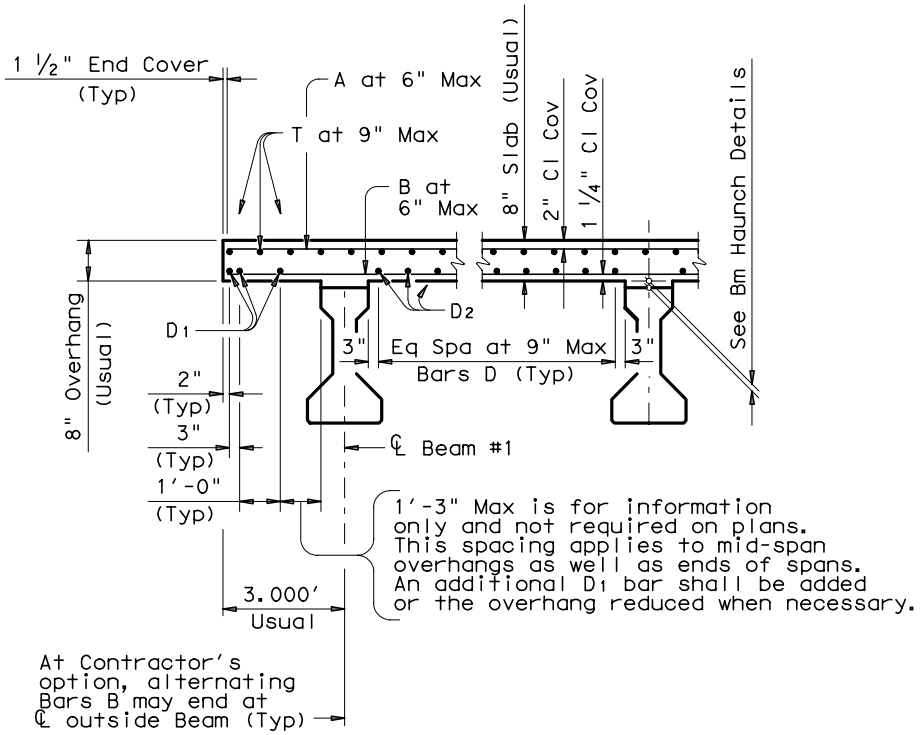
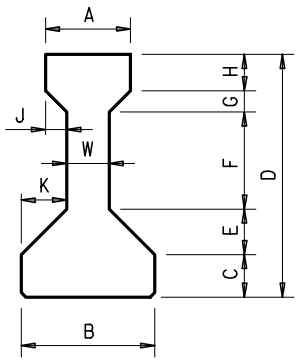


Figure 5-19: Typical Transverse Section Reinforcing. Online users can click 5-19 to view this illustration in PDF.

Section 10
Beam Types and Dimensions

Prestressed Concrete I-Beam Quick Reference

The following table is provided as a quick reference guide to the TxDOT prestressed concrete I-Beam shapes. See the standard sheet "IBA" for additional details.

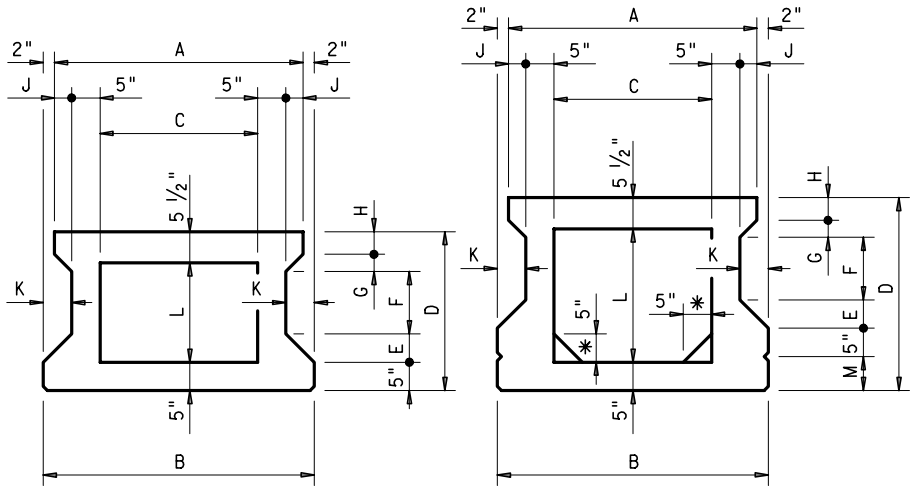


Beam Type	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"	"J"	"K"	"W"	Wt/LF
	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	Lb
A	12	16	5	28	5	11	3	4	3	5	6	287
B	12	18	6	34	5 ¾	14	2 ¾	5 ½	2 ¾	5 ¾	6 ½	375
C	14	22	7	40	7 ½	16	3 ½	6	3 ½	7 ½	7	516
IV	20	26	8	54	9	23	6	8	6	9	8	821
54	16	16	8	54	5	32	5	4	5	5	6	514
72	22	22	11	72	7 ½	40 ½	7 ½	5 ½	7 ½	7 ½	7	899

Figure 5-20: Prestressed Concrete I-Beam Quick Reference. Online users can click 5-20 to view this illustration in PDF.

Prestressed Concrete TxDOT Box Beam Quick Reference

The following table is provided as a quick reference guide to the TxDOT prestressed concrete box beam shapes.



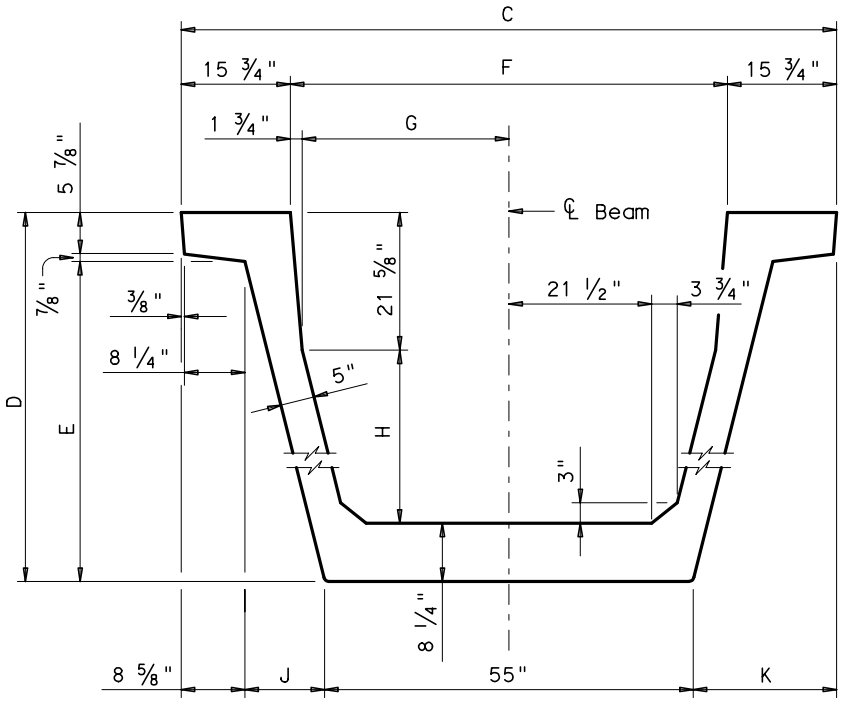
* 40" Beams over 100' only

Beam Type	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"	"J"	"K"	"L"	"M"	Wt/LF
	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	Lb
4B20	43 ¾	47 ¾	29 ¾	20	4	4	2	5	2	4	9 ½	-	616
5B20	55 ¾	59 ¾	41 ¾	20	4	4	2	5	2	4	9 ½	-	748
4B28	43 ¾	47 ¾	27 ¾	28	5	11	3	4	3	5	17 ½	-	707
5B28	55 ¾	59 ¾	39 ¾	28	5	11	3	4	3	5	17 ½	-	838
4B34	43 ¾	47 ¾	27 ¾	34	5	11	3	4	3	5	23 ½	6	832
5B34	55 ¾	59 ¾	39 ¾	34	5	11	3	4	3	5	23 ½	6	963
4B40	43 ¾	47 ¾	27 ¾	40	5	11	3	4	3	5	29 ½	12	957
5B40	55 ¾	59 ¾	39 ¾	40	5	11	3	4	3	5	29 ½	12	1,088
*4B40	43 ¾	47 ¾	27 ¾	40	5	11	3	4	3	5	29 ½	12	983
*5B40	55 ¾	59 ¾	39 ¾	40	5	11	3	4	3	5	29 ½	12	1,114

Figure 5-21: Prestressed Concrete TxDOT Box Beam Quick Reference. Online users can click 5-21 to view this illustration in PDF.

Prestressed Concrete U-Beam Quick Reference

The following table is provided as a quick reference guide to the TxDOT prestressed concrete U-Beam shapes. See the U-Beam standards for additional details.

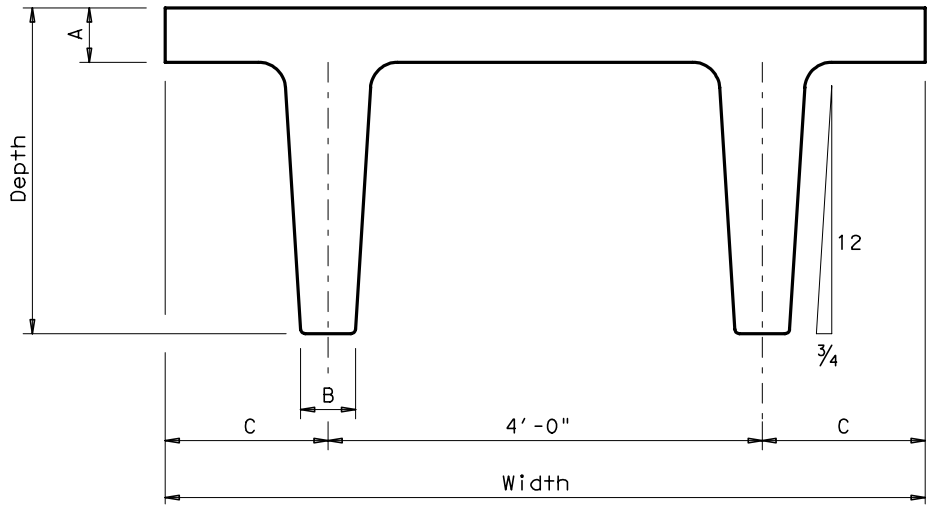


Beam Type	"C"	"D"	"E"	"F"	"G"	"H"	"J"	"K"	Wt/LF
	In.	In.	In.	In.	In.	In.	In.	In.	Lb
U40	89	40	33 1/4	57 1/2	27	10 1/8	8 3/8	17	1,021
U54	96	54	47 1/4	64 1/2	30 1/2	24 1/8	11 7/8	20 1/2	1,167

Figure 5-22: Prestressed Concrete U-Beam Quick Reference. Online users can click 5-22 to view this illustration in PDF.

Prestressed Concrete TxDOT Double-T Beam Quick Reference

The following table is provided as a quick reference guide to the TxDOT prestressed concrete double-T beam shapes. See the double-T standards for additional details.



BEAM TYPE		DEPTH	WIDTH	"A"	"B"	"C"	Wt/LF
		In.	Ft	In.	In.	Ft	Lb
With Concrete Slab	6T21	20 ½	6.0	4 ½	7 ¾	1.0	633
	7T21	20 ½	7.0	4 ½	7 ¾	1.5	689
	8T21	20 ½	8.0	4 ½	7 ¾	2.0	745
	6T27	26 ½	6.0	4 ½	7	1.0	725
	7T27	26 ½	7.0	4 ½	7	1.5	781
	8T27	26 ½	8.0	4 ½	7	2.0	837
	6T35	34 ½	6.0	4 ½	6	1.0	833
	7T35	34 ½	7.0	4 ½	6	1.5	889
	8T35	34 ½	8.0	4 ½	6	2.0	946
With ACP Overlay	6T22	22	6.0	6	7 ¾	1.0	745
	7T22	22	7.0	6	7 ¾	1.5	820
	8T22	22	8.0	6	7 ¾	2.0	895
	6T28	28	6.0	6	7	1.0	837
	7T28	28	7.0	6	7	1.5	912
	8T28	28	8.0	6	7	2.0	987
	6T36	36	6.0	6	6	1.0	946
	7T36	36	7.0	6	6	1.5	1,021
	8T36	36	8.0	6	6	2.0	1,096

Figure 5-23: Prestressed Concrete TxDOT Double-T Beam Quick Reference. Online users can click 5-23 to view this illustration in PDF.

Beam End Conditions

The following detail is a quick reference guide to TxDOT prestressed beam end conditions and dimensions.

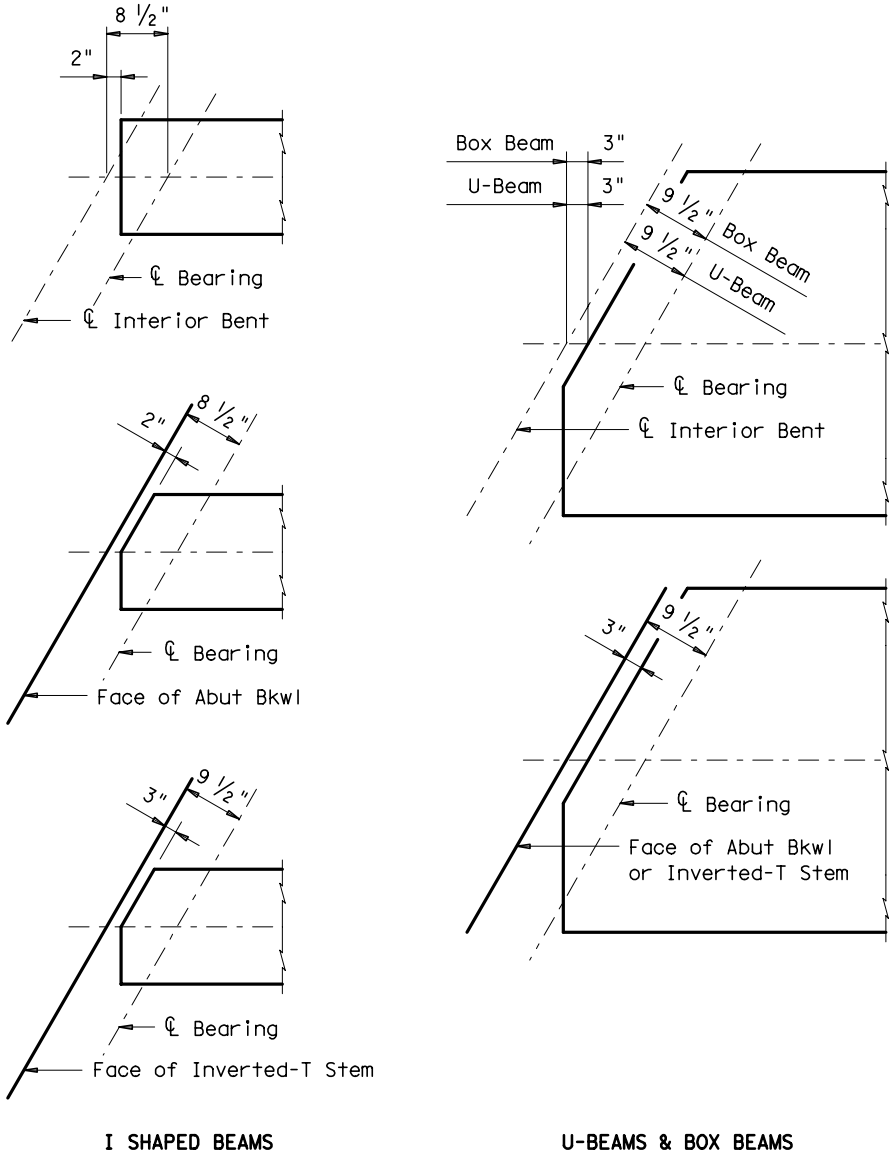


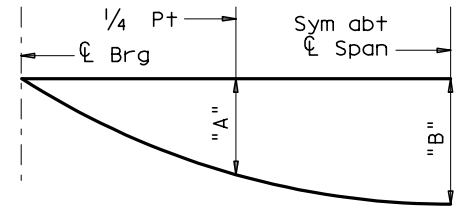
Figure 5-24: Beam End Conditions. Online users can click 5-24 to view this illustration in PDF.

Section 11
Miscellaneous Details

Dead Load Deflection Diagram Example

Showing a typical dead load deflection diagram for a prestressed concrete I-beam unit

Span No.	Beam No.	"A" Ft	"B" Ft
1	All	0.103	0.145
2	1-3	0.116	0.163
2	4	0.061	0.085



DEAD LOAD
DEFLECTION DIAGRAM

NOTE: Deflections shown are due to concrete slab only. ($E_c = 5 \times 10^6$ psi) Calculated deflections shown are theoretical and actual dimensions may be less. Deflections shall be adjusted based on field observations.

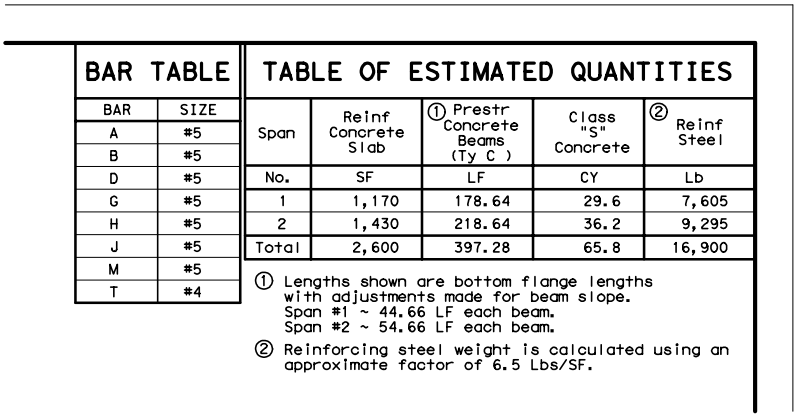
Figure 5-25: Dead Load Deflection Diagram Example. Online users can click 5-25 to view this illustration in PDF.

Table of Estimated Quantities and Bar Table

Tables of estimated quantities shall normally be shown on the plan view as detailed below. If the detail sheet is for more than one interior bent, a numbered note, as shown below, shall be included with the table.

Quantities shall be shown in the tables as listed below:

- Reinforced Concrete Slab - in square feet to the nearest 1 square foot
- Prestressed Concrete Beams - in linear feet to the nearest 0.01 feet
- Class “S” Concrete - in cubic yards to the nearest 0.1 cubic yard
- Reinforcing Steel - in pounds to the nearest pound using an approximate factor of 6.5 lbs/SF (Designer should verify 6.5 lbs/SF for special designs)



BAR TABLE

BAR	SIZE
A	#5
B	#5
D	#5
G	#5
H	#5
J	#5
M	#5
T	#4

TABLE OF ESTIMATED QUANTITIES

Span	Reinf Concrete Slab	① Prestr Concrete Beams (Ty C)	Class "S" Concrete	② Reinf Steel
No.	SF	LF	CY	Lb
1	1,170	178.64	29.6	7,605
2	1,430	218.64	36.2	9,295
Total	2,600	397.28	65.8	16,900

① Lengths shown are bottom flange lengths with adjustments made for beam slope.
Span #1 ~ 44.66 LF each beam.
Span #2 ~ 54.66 LF each beam.

② Reinforcing steel weight is calculated using an approximate factor of 6.5 Lbs/SF.

Figure 5-26: Typical Bar Table and Estimated Quantities Table. Online users can click 5-26 to view this illustration in PDF.

General Notes, Title Block, and P.E. Seal

The general notes, title block, and engineer's seal shall normally be shown on the detail sheet in the format given below. Note that there will be considerable variation in the general notes between jobs, depending on structural needs. Particular care shall be taken to ensure that the loading criteria given are correct.

Whenever possible, space should be made available on the sheet to the immediate left of the title block for the engineer's seal.

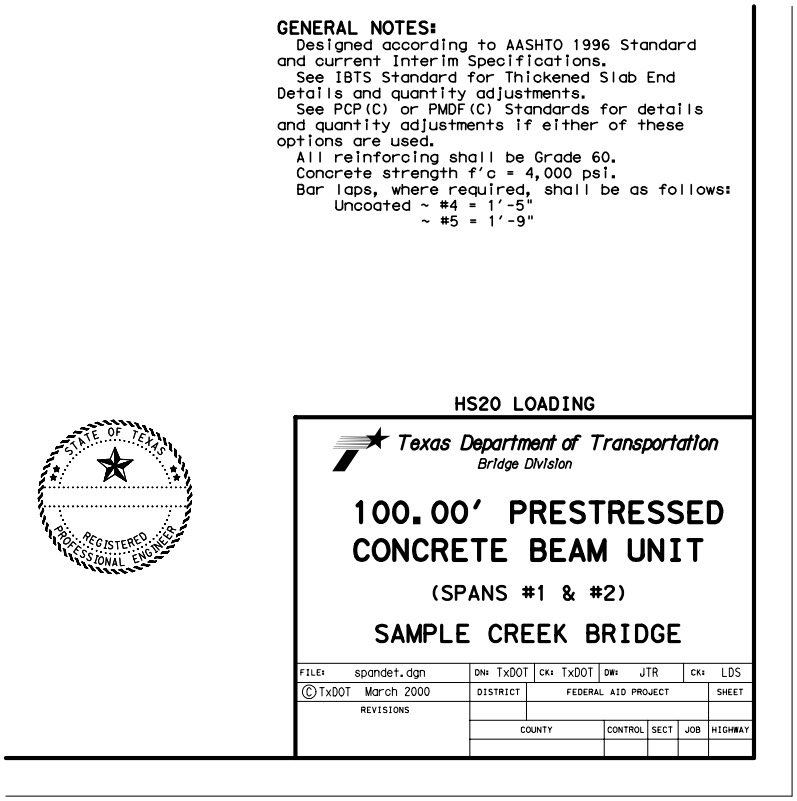


Figure 5-27: Typical General Notes, Title Block, and P.E. Seal. Online users can click 5-27 to view this illustration in PDF.

Chapter 6
Structural Steel

Contents:

Section 1
General Information

Preferred Steel Beam Span or Multiple Span Unit Scales

The Steel Beam Span (or multiple span unit) Details Sheet(s) shall normally contain, but is not limited to, the following listed details (showing preferred scales):

- Plan View - 3/8" = 1'-0" or 1/4" = 1'-0" (scale appropriate for structure size)
- Typical Transverse or Radial Section - 3/8" = 1'-0" or 1/2" = 1'-0"
- Concrete Placement Sequence - (scale appropriate for structure size and clarity)
- Beam Elevation - (scale appropriate for structure size and clarity)
- Framing Plan - (scale appropriate for structure size and clarity)
- Optional Bolted Field Splice - (scale appropriate for structure size and clarity)
- Dead Load Deflection Diagram
- Beam Fabrication Notes
- Table of Estimated Quantities
- General Notes.

Preferred Steel Plate Girder Span or Multiple Span Unit Scales

The Steel Plate Girder Span (or multiple span unit) Details Sheet(s) shall normally contain, but is not limited to, the following listed details (showing preferred scales):

- Plan View - 3/8" = 1'-0" or 1/4" = 1'-0" (scale appropriate for structure size)
- Typical Transverse or Radial Section - 3/8" = 1'-0" or 1/2" = 1'-0"
- Concrete Placement Sequence - (scale appropriate for structure size and clarity)
- Girder Elevation - (scale appropriate for structure size and clarity)
- Framing Plan - (scale appropriate for structure size and clarity)
- Optional Bolted Field Splice - (scale appropriate for structure size and clarity)
- Dead Load Deflection Diagram
- Web Camber Diagram
- Girder Fabrication Notes
- Table of Estimated Quantities
- General Notes.

Plan view and framing plan should be shown with increasing stations to the right. Typical transverse/radial sections should be facing forward station. Beam/girder numbers begin with the leftmost beam (looking forward station).

NOTE: The slab thickness on the typical transverse section may be exaggerated for clarity.

See Chapter 5 for miscellaneous slab information and typical slab reinforcement.

Dimensions shall normally be shown on the Span (or Unit) Details Sheet as listed below:

- Slab Plan and Framing Plan - All structural dimensions in decimal feet to the nearest 0.001', except controlled joint or construction joint dimensions in feet and inches to the nearest 1/4".
- Transverse or Radial Section - All structural dimensions in feet and inches to the nearest 1/4" except beam/girder spacing in decimal feet to the nearest 0.001'.
- Concrete Placement Sequence - All dimensions in decimal feet to the nearest 0.001'.
- Beam and Girder Elevation - All dimensions in decimal feet to the nearest 0.001'. Shear connector spacing in feet and inches.
- Reinforcing Steel - Dimensions, spacing, and locations in all views, including bar details, shall normally be in feet and inches to the nearest 1/4". All measurements are to the centerlines of bars.
- Cover - Cover for the top slab reinforcing is 2" clear cover and bottom slab reinforcing is 1 1/4" clear cover. Transverse bars have 1 1/2" end cover and longitudinal bars have 2" end cover.
- Angles and Bearings - In degrees, minutes, seconds to the nearest whole second, if such accuracy is available.
- Stationing - Show to the nearest 0.001' if such accuracy is available
- Dead Load Deflection, Vertical Blocking, and Horizontal Blocking Ordinates - Show in decimal feet to nearest 0.001'.
- Web Camber Ordinates - Show in decimal feet to nearest 0.01'
- Bolt Spacing - Show in feet and inches.

Section 2
Continuous Steel Beam/Plate Girder Units

Continuous Steel Beam/Plate Girder Units Examples

These sheets are included to provide an example of the drafting layout of typical Steel Unit Sheets. See the various sections of this chapter for directions on drawing particular details. Note that the plan view of a span is normally detailed with the direction of increasing stations to the right and the typical transverse/radial section is shown facing the direction of increasing station.

Example – Continuous Beam Unit

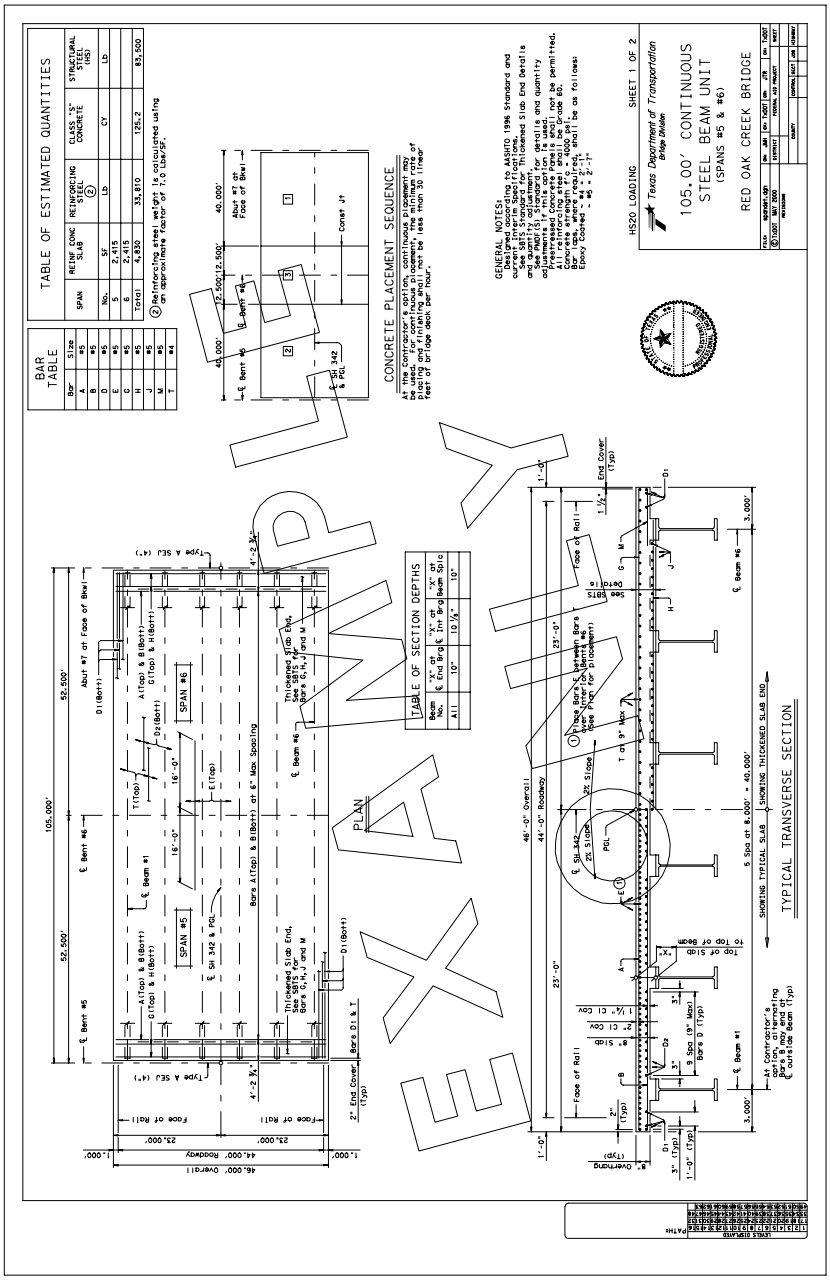


Figure 6-1: Example - Continuous Beam Unit. Online users can click 6-1 to view this illustration in PDF.

Example – Continuous Beam Unit (Sheet 2)

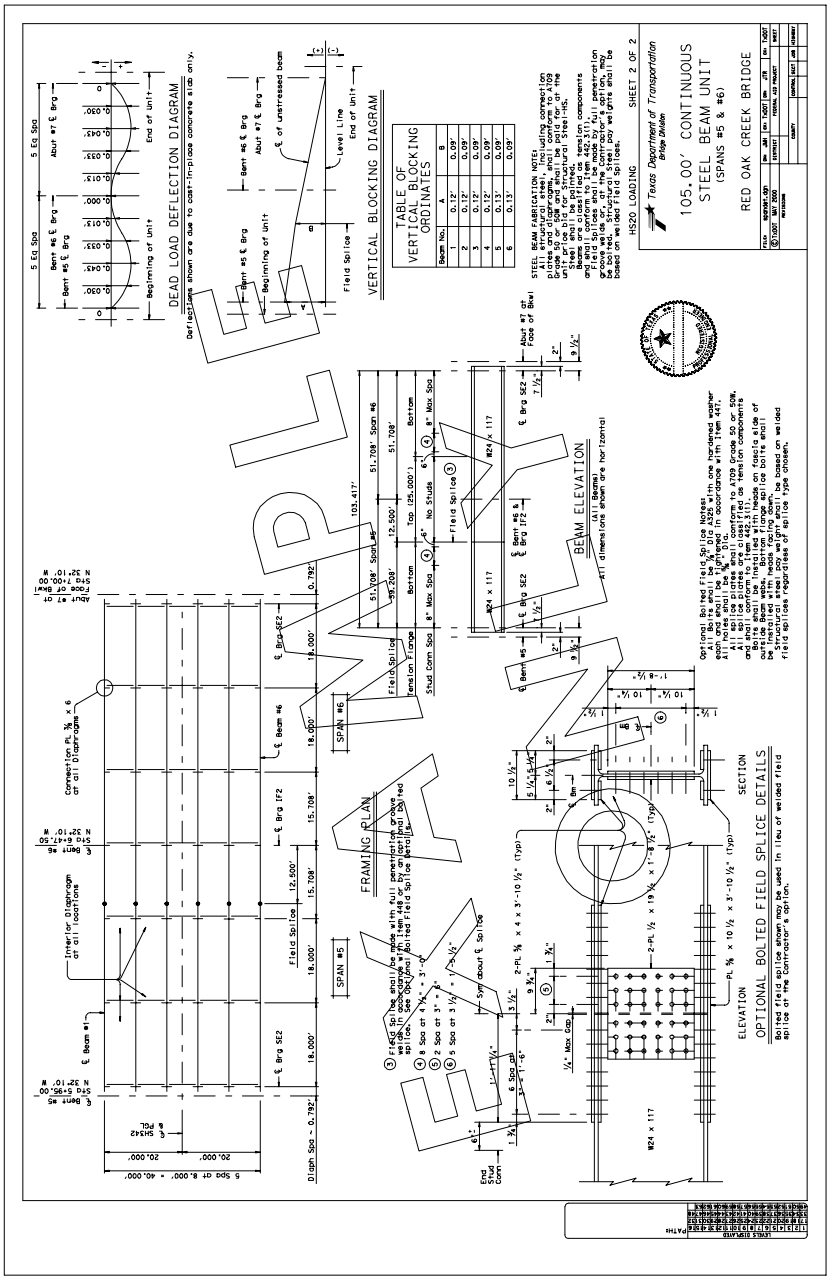


Figure 6-2: Example - Continuous Beam Unit (Sheet 2). Online users can click 6-2 to view this illustration in PDF.

Example – Continuous Plate Girder Unit

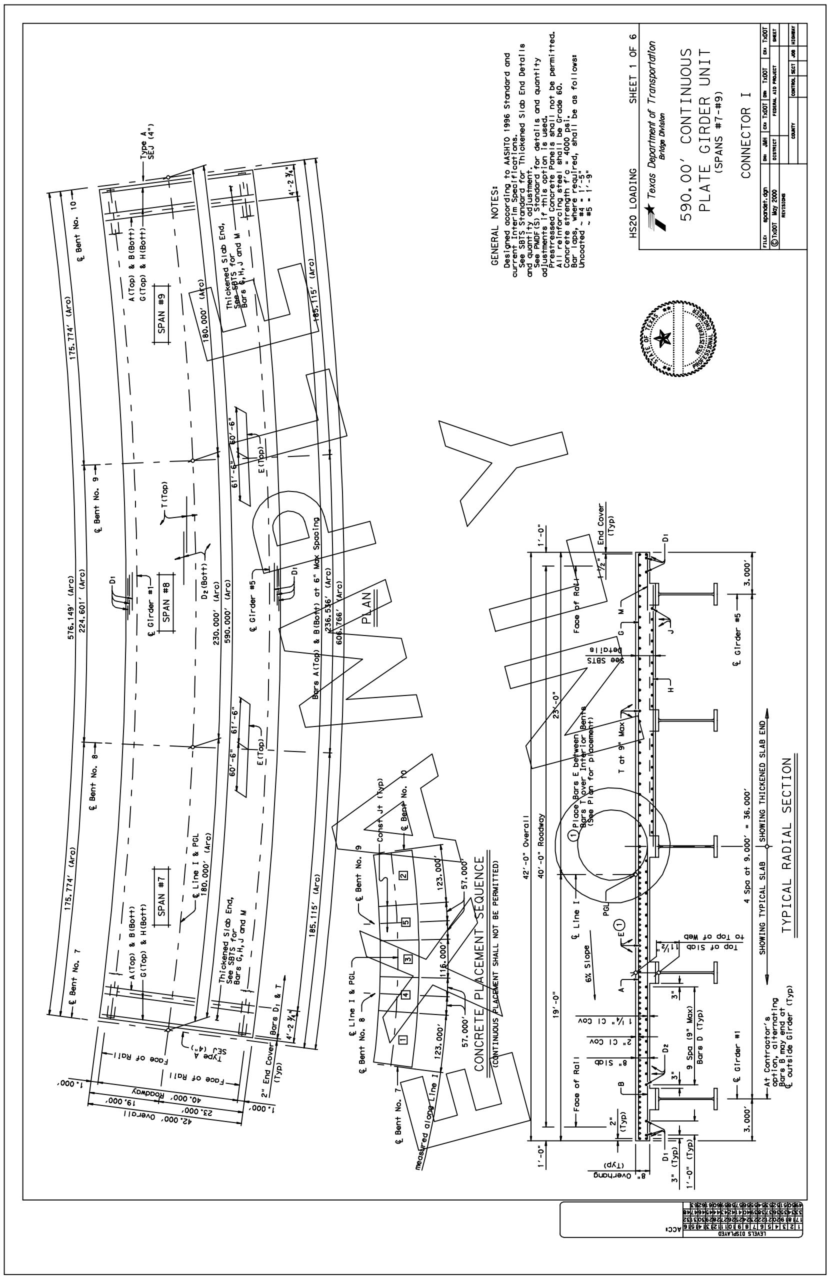


Figure 6-3: Example - Continuous Plate Girder Unit. Online users can click 6-3 to view this illustration in PDF.

Example – Continuous Plate Girder Unit (Sheet 2)

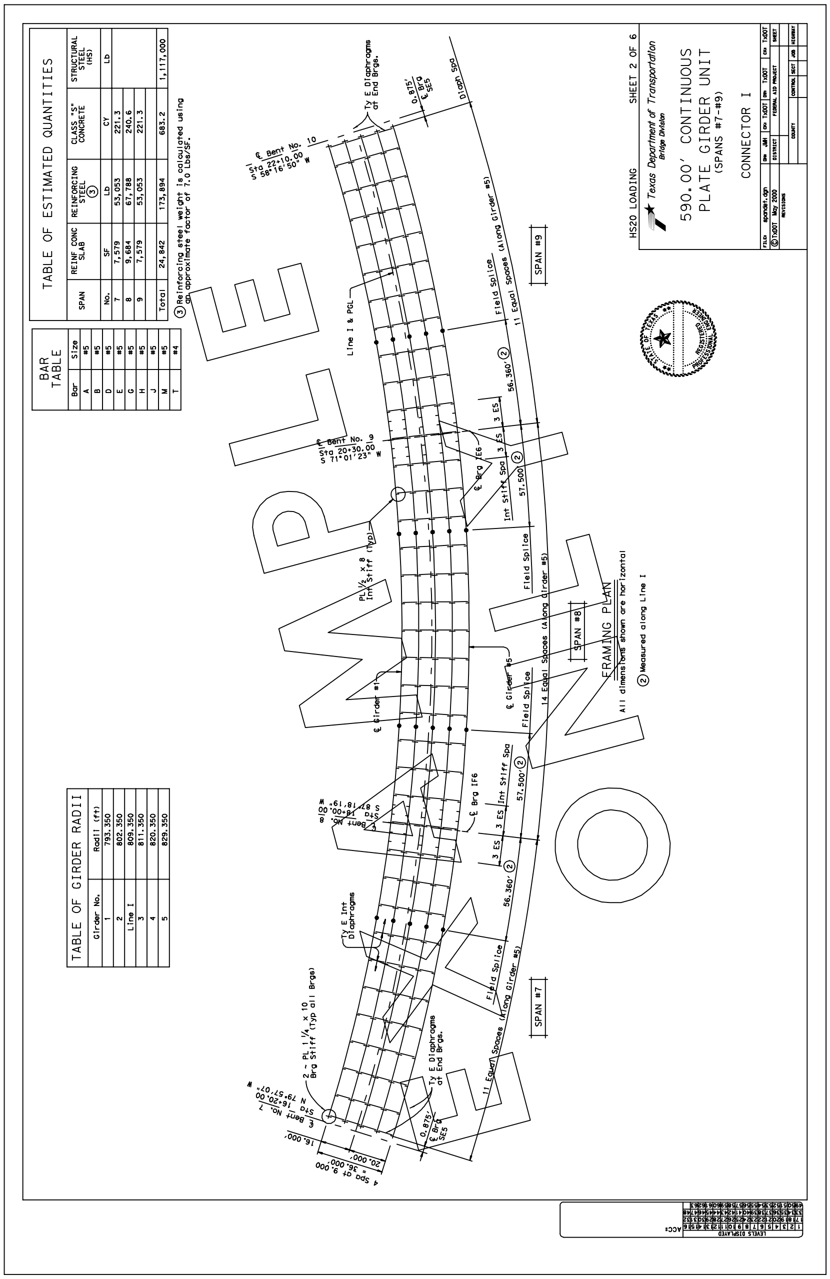


Figure 6-4: Example - Continuous Plate Girder Unit (Sheet 2). Online users can click 6-4 to view this illustration in PDF.

Example – Continuous Plate Girder Unit (Sheet 3)

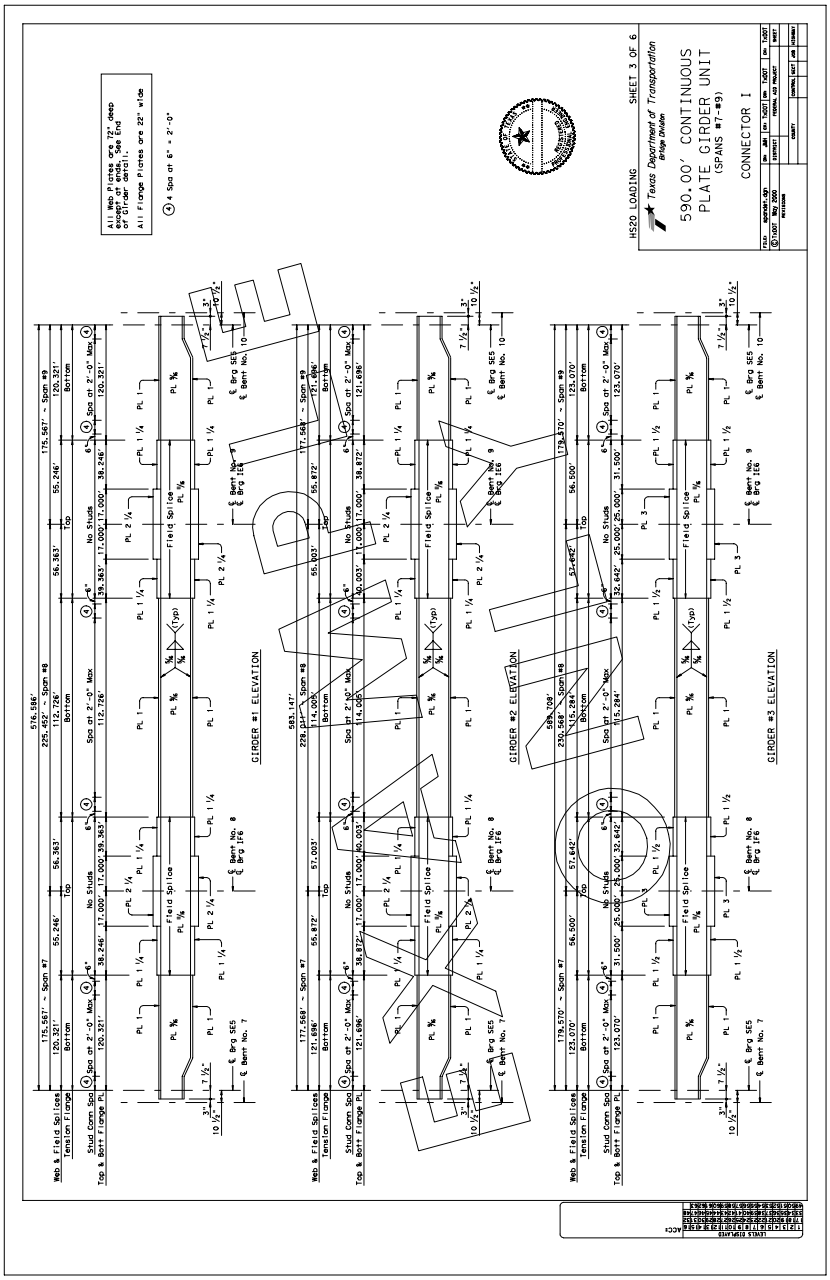


Figure 6-5: Example - Continuous Plate Girder Unit (Sheet 3). Online users can click 6-5 to view this illustration in PDF.

Example – Continuous Plate Girder Unit (Sheet 4)

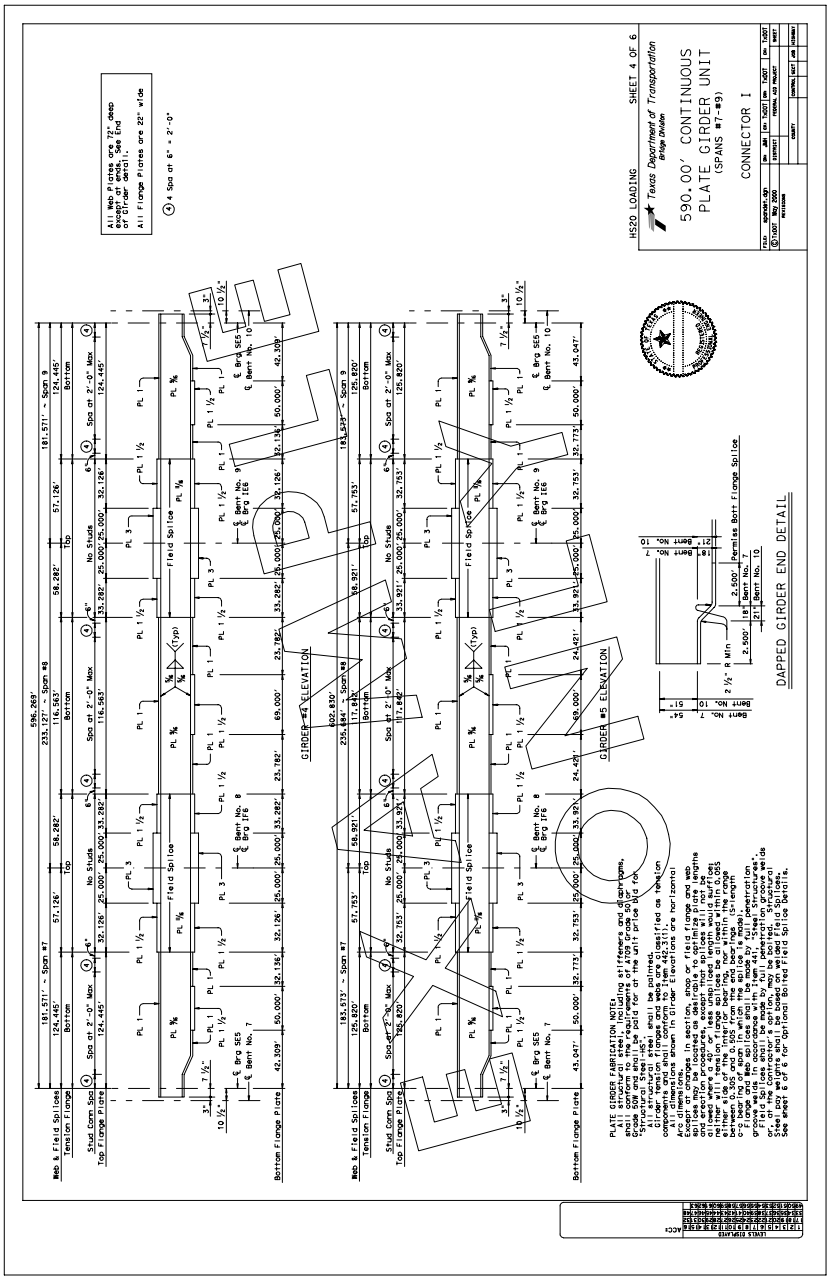


Figure 6-6: Example - Continuous Plate Girder Unit (Sheet 4). Online users can click 6-6 to view this illustration in PDF.

Example – Continuous Plate Girder Unit (Sheet 5)

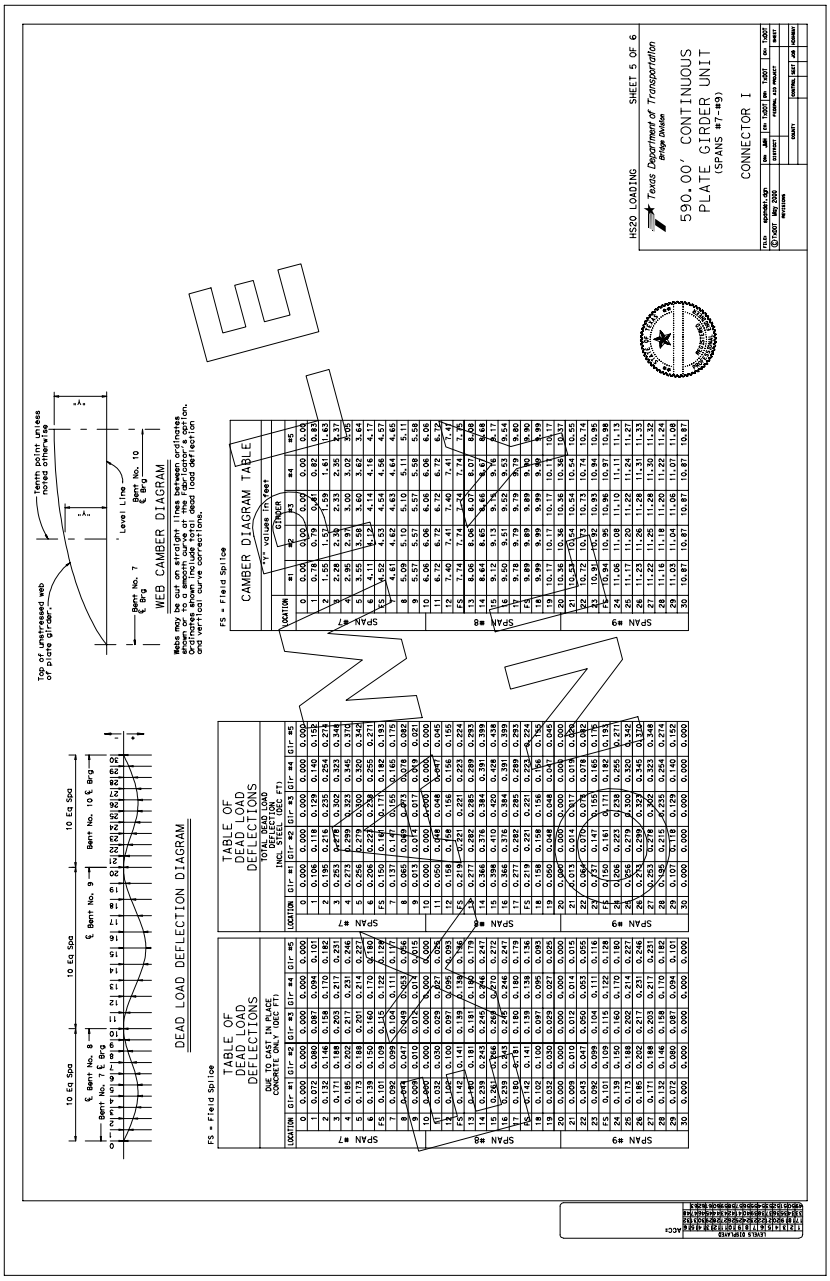


Figure 6-7: Example - Continuous Plate Girder Unit (Sheet 5). Online users can click 6-7 to view this illustration in PDF.

Example – Continuous Plate Girder Unit (Sheet 6)

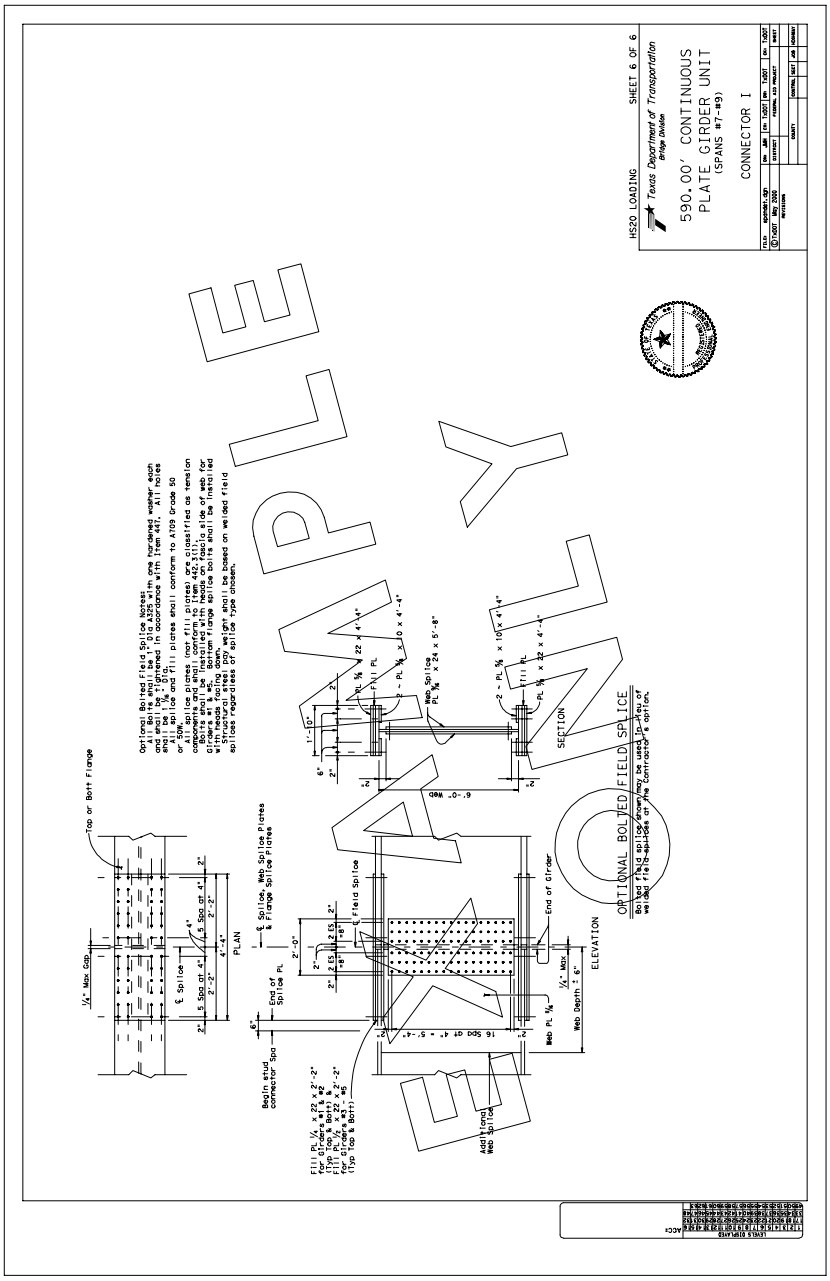


Figure 6-8: Example - Continuous Plate Girder Unit (Sheet 6). Online users can click 6-8 to view this illustration in PDF.

Section 3
Steel Beam Superstructure Checklist

Plan View

Accurate, measurable detail, with exceptions to enhance clarity.

1. ☐ Label and locate the control line at transverse and skewed ends of units, simple spans and spans within a multiple span unit if different (matching the terminology on the layout, such as reference line, centerline, or profile grade line). Locate all defining points (e.g., **PC** , **PT** , **PCC** .).

2. ☐ Control dimensions shall be referenced to a working point (usually the intersection of the control line and the centerlines of bents and at the ends of the unit).

3. ☐ Overall unit length and individual span lengths dimensioned along the control line (and along the slab edges if different).

4. ☐ Label joint locations (including construction joint or controlled joint, expansion joint, etc.). If beams are continuous, construction joints should be shown on the concrete placement sequence detail.

5. ☐ Transverse widths of slab dimensioned, including overall, roadway, face of rail, curb, sidewalk and median widths, and working point locations at the beginning of the unit (and, if the unit contains variables width spans, and the ends of each span).

6. ☐ Dimension the 2.000' breakback on slabs with skews greater than 15°.

7. ☐ Outside beam lines located and numbered.

8. ☐ Skew angles (on structure with curved control lines, the angle is between a perpendicular and a tangent to the control line's horizontal curve at the working points at the end of spans).

9. ☐ Slab reinforcing detailed, spacing dimensioned, and end cover shown.

10. ☐ Show abutment numbers and/or bent numbers.

11. ☐ Skewed end dimensioned and control line located.

12. ☐ If thickened slab ends are used, label them and make reference to the standard sheet SBTS for reinforcing and construction details.

13. ☐ Show span numbers.

Typical Transverse/Radial Section

Accurate, measurable detail, with exceptions to enhance clarity.

1. ☐ Location of the control line horizontally and the profile grade line vertically (note that more than one control line or profile grade line may be required). Show the horizontal offset between control line and profile if present.

2. ☐ Slab width dimensioned (including overall, roadway, face of rail, offset from control line, etc.)

3. ☐ Reinforcing shown for typical slab section and, if used, thickened slab ends.

4. ☐ Reinforcing cover and slab thickness (interior and overhang)

5. ☐ Slab depths at centerlines of bearing and at beam splice points for continuous beams (using table if required)

6. ☐ Beam spacing and identification

7. ☐ Crown or roadway slope

8. ☐ Spacing for bars T and D and locate bars E for continuous units.

9. ☐ Overlay information (if required)

Concrete Placement Sequence (needed only for continuous beams)

Accurate, measurable detail, with exceptions to enhance clarity.

1. ☐ Location of construction joints along control line and show relationship between bents and abutments

2. ☐ Sequence number inside a square

3. ☐ Note allowing or disallowing continuous placement

Beam Elevation

Accurate, measurable detail, with exceptions to enhance clarity.

It is preferable to detail individual beam elevations if span lengths vary. A table of variable dimensions should be used only if the number of beam elevations is deemed excessive.

1. ☐ Overall length of beams and individual span lengths shown from centerlines of bearing. Dimension beam ends and bearing centerlines to bent and abutment centerlines.

2. ☐ Location of field and shop splices and show relationship to centerlines of bearing

3. ☐ Size of beams

4. ☐ Shear connector spacing

5. ☐ Locate tension flanges

6. ☐ Type of steel (give **ASTM** designation) for beams, stiffeners/connection plates, and diaphragms (if not given in Beam Fabrication Notes)

7. ☐ how bearing type

Framing Plan

Accurate, measurable detail, with exceptions to enhance clarity.

1. ☐ Abutment and bent stations and their bearing
2. ☐ Beam spacing at each bent; beam spacing at each splice for continuous beams chorded along curve
3. ☐ Location of control line and its relationship to beam 1 and, if dimension varies, locate at each bent/abutment. Locate all defining points for control line e.g., **PC** , **PT** , etc.
4. ☐ Show span numbers.
5. ☐ Number outside beams.
6. ☐ Show beam angles.
7. ☐ Locate centerline of bearing at all bents/abutments.
8. ☐ Show location of stiffeners/connection plates.
9. ☐ Spacing of diaphragms
10. ☐ Length of diaphragms, center to center of beams, if varying
11. ☐ Types of diaphragms
12. ☐ Angle between diaphragms and beams if not 90°
13. ☐ Locate field splices and show relationship to centerlines of bearing.
14. ☐ Bearing type
15. ☐ Locate drip tabs for unpainted weathering steel beams.
16. ☐ Beam and bent report from Roadway Design System (RDS) may be attached to provide some of the required information.

Optional Bolted Field Splice (if needed)

Accurate, measurable detail, with exceptions to enhance clarity.

1. ☐ Identify beam and location for each splice.
2. ☐ Identify thickness, width, and length of splice plates.
3. ☐ Indicate type of steel (give **ASTM** designation) for the splice plate material.
4. ☐ Show vertical and horizontal bolt spacing.
5. ☐ Give hole size, bolt size, **ASTM** designation, and washer requirements.
6. ☐ Show hole edge distances.
7. ☐ Note payment based on welded field splice.
8. ☐ Identify splice plates as tension components.
9. ☐ Note any special faying surface preparation that may be required or permitted.
10. ☐ Show adjustment to shear connector spacing (omit from top of splice plate).

Other Details

Accurate, measurable detail, with exceptions to enhance clarity.

1. ☐ Special bearing details, if required
2. ☐ Dead load deflection diagram (slab only) at tenth or fifth points of spans, c-c bearings (distance between increments should range between 20' and 5')
3. ☐ Vertical blocking diagram with ordinates at end bearings and all beam splices, using table if required
4. ☐ Special details for corners of slab or skew, showing reinforcing details and break lines
5. ☐ Special diaphragm details, such as for diaphragms skewed over 15°
6. ☐ Horizontal blocking diagram for continuous beams chorded along curve
7. ☐ Bar details (if required)
8. ☐ Bar table
9. ☐ Joint details (if required)
10. ☐ Drip tab details (if required)
11. ☐ Table of quantities
12. ☐ Beam camber diagram (if required)
13. ☐ Beam fabrication notes
14. ☐ General notes (including, but not limited to, design criteria, loading, class of concrete, epoxy coating, and cross references to various standard sheets)
15. ☐ Title block, information block, and engineer's seal

Final Checks

1. ☐ Check all details and dimensions against substructure to ensure details are not in conflict.

2. ☐ Double check all bars in various details against the bars shown in the bar table.

3. ☐ Ensure that the name of the bridge is the same on all detail sheets (including layout).

4. ☐ Initial the sheet after back-checking corrected details.

Section 4
Steel Girder Superstructure Checklist

Plan View

Accurate, measurable detail, with exceptions to enhance clarity.

1. ☐ Label and locate the control line at transverse and skewed ends of units, simple spans and spans within a multiple span unit if different (matching the terminology on the layout, such as reference line, centerline, or profile grade line). Locate all defining points (e.g., **PC** , **PT** , **PCC** , etc.).

2. ☐ Control dimensions shall be referenced to a working point (usually the intersection of the control line and the centerlines of bents and at the ends of the unit).

3. ☐ Overall unit length and individual span lengths dimensioned along the control line (and along the slab edges if different)

4. ☐ Label joint locations (including construction joint or controlled joint, expansion joint, etc.). If girders are continuous, construction joints should be shown on the concrete placement sequence detail.

5. ☐ Transverse widths of slab dimensioned including overall, roadway, face of rail, curb, sidewalk and median widths, and working point locations at the beginning of the unit (and, if the unit contains variable widths spans, at the ends of each span).

6. ☐ Dimension the 2.000' breakback on slabs with the skews greater than 15°.

7. ☐ Outside girder lines located and numbered

8. ☐ Skew angles (on structures with curved control lines, the angle between a perpendicular and a tangent to the control line's horizontal curve at the working points at the ends of spans).

9. ☐ Slab reinforcing detailed, spacing dimensioned and end cover shown

10. ☐ Show abutment numbers and/or bent numbers.

11. ☐ Skewed end dimensioned and control line located

12. ☐ If thickened slab ends are used, label them and make reference to the standard sheet SBTS for reinforcing and construction details.

13. ☐ Show span numbers.

Typical Transverse/Radial Section

Accurate, measurable detail, with exceptions to enhance clarity.

1. ☐ Location of the control line horizontally and the profile grade line vertically (note that more than one control line or profile grade line may be required). Show the horizontal offset between control line and profile grade line if present.
2. ☐ Slab width dimensioned (including overall, roadway, face of rail, offset from control line, etc.)
3. ☐ Reinforcing shown for typical slab section and, if used, thickened slab ends.
4. ☐ Reinforcing cover and slab thickness (interior and overhang)
5. ☐ Top of slab to top of web dimension
6. ☐ Girder spacing and identification
7. ☐ Crown or roadway slope
8. ☐ Spacing for bars T and D and locate bars E for continuous units.
9. ☐ Overlay information (if required)

Concrete Placement Sequence (needed only for continuous girders)

Accurate, measurable detail, with exceptions to enhance clarity.

1. ☐ Location of construction joints along control line and show relationship between bents and abutments
2. ☐ Sequence Number inside a square
3. ☐ Note allowing or disallowing continuous placement

Girder Elevation

Accurate, measurable detail, with exceptions to enhance clarity.

It is preferable to detail individual girder elevations if span or plate lengths vary. A table of variable dimensions should be used only if the number of girder elevations is deemed excessive.

1. ☐ Overall length of girders and individual span lengths shown from centerlines of bearing. Dimension girder ends and bearing centerlines to bent and abutment centerlines.

2. ☐ Location of field splices, including optional field splices if required, and show relationship to centerlines of bearing

3. ☐ Size of lengths of web plate and show relationship to centerlines of bearing

4. ☐ Size and lengths of flange plate and show relationship to centerlines of bearing

5. ☐ Shear connector spacing

6. ☐ Locate tension flanges

7. ☐ Type of steel (give **ASTM** designation) for flanges, webs, stiffeners, and diaphragms (if not given in Girder Fabrication Notes)

8. ☐ Show bearing type

9. ☐ Show size and location of flange to web weld

Framing Plan

Accurate, measurable detail, with exceptions to enhance clarity.

1. ☐ Abutment and bent stations and their bearing
2. ☐ Girder spacing at each bent
3. ☐ Location of control line and its relationship to girder 1 and, if dimension varies, locate at each bent/abutment. Locate all defining points for control line (e.g., **PC** , **PT** , etc.).
4. ☐ Show span numbers.
5. ☐ Number outside girders.
6. ☐ Show girder angles.
7. ☐ Locate centerline of bearing at all bents/abutments.
8. ☐ Show size, location, and spacing of stiffeners.
9. ☐ Spacing of diaphragms
10. ☐ Length of diaphragms, center to center of girders, if varying
11. ☐ Types of diaphragms
12. ☐ Angle between diaphragms and girders if not 90°
13. ☐ Locate field splices and show relationship to centerlines of bearing.
14. ☐ Bearing type
15. ☐ Locate drip tabs for unpainted weathering steel girders.
16. ☐ Beam and bent report from Roadway Design System (RDS) may be attached to provide some of the required information.

Optional Bolted Field Splice (if needed)

Accurate, measurable detail, with exceptions to enhance clarity.

1. ☐ Identify girder and location for each splice.
2. ☐ Identify thickness, width, and length of splice plates.
3. ☐ Indicate type of steel (give **ASTM** designation) for the splice plate material.
4. ☐ Show vertical and horizontal bolt spacing.
5. ☐ Give hole size, bolt size, ASTM designation, and washer requirements.
6. ☐ Show hole edge distances.
7. ☐ Note payment based on welded field splice.
8. ☐ Identify splice plates as tension components.
9. ☐ Note any special faying surface preparation that may be required or permitted.
10. ☐ Show adjustment to shear connector spacing (omit from top of splice plate).

Other Details

Accurate, measurable detail, with exceptions to enhance clarity.

1. ☐ Special bearing details, if required
2. ☐ Dead load (separate slab only and total) deflection diagram at tenth points of spans, c-c bearings, and field splices
3. ☐ Web camber diagram ordinates given at tenth points of spans and field splices (ordinates defined as including total dead load deflections and vertical curve corrections)
4. ☐ Special details for corners of slab or skew, showing reinforcing details and break lines
5. ☐ Special diaphragm details, such as for diaphragms skewed over 15°
6. ☐ Table of girder radii, including radius of control line, if required
7. ☐ Bar details (if required)
8. ☐ Bar table
9. ☐ Joint details (if required)
10. ☐ Drip tab details (if required)
11. ☐ Dapped girder end detail (if required)
12. ☐ Table of quantities
13. ☐ Girder fabrication notes
14. ☐ General notes (including, but not limited to, design criteria, loading, class of concrete, epoxy coating, and cross references to various standard sheets). Disallow use of prestressed concrete panels on curved girders.
15. ☐ Title block, information block, and engineer's seal

Final Checks

1. ☐ Check all details and dimensions against substructure to ensure details are not in conflict.
2. ☐ Double check all bars in various details against the bars shown in the bar table.
3. ☐ Ensure that the name of the bridge is same on all detail sheets (including Layout).
4. ☐ Initial the sheet after back-checking corrected details.

Section 5
Typical Transverse/Radial Section

Steel Beam or Plate Girder Transverse/Radial Section

Typical transverse or radial sections are shown similar to prestressed concrete beam spans with the following differences:

- Bars E, normally #5 bars, are shown placed between bars T for continuous beam/girder units. Reference plan view for location. The location and length of these bars is to be determined by the designer.
- For plate girder spans/units, indicate the dimension between top of slab to top of web. No overall section depth dimension is required.
- For beam spans/units, indicate the slab depth at all centerlines of bearing and, if there is a vertical blocking diagram, at all beam splice locations that are indicated on blocking diagram. A table of slab depths may be required.
- If thickened slab end is used, note that no beam blockout is shown on the typical section as would be done with prestressed concrete beams.

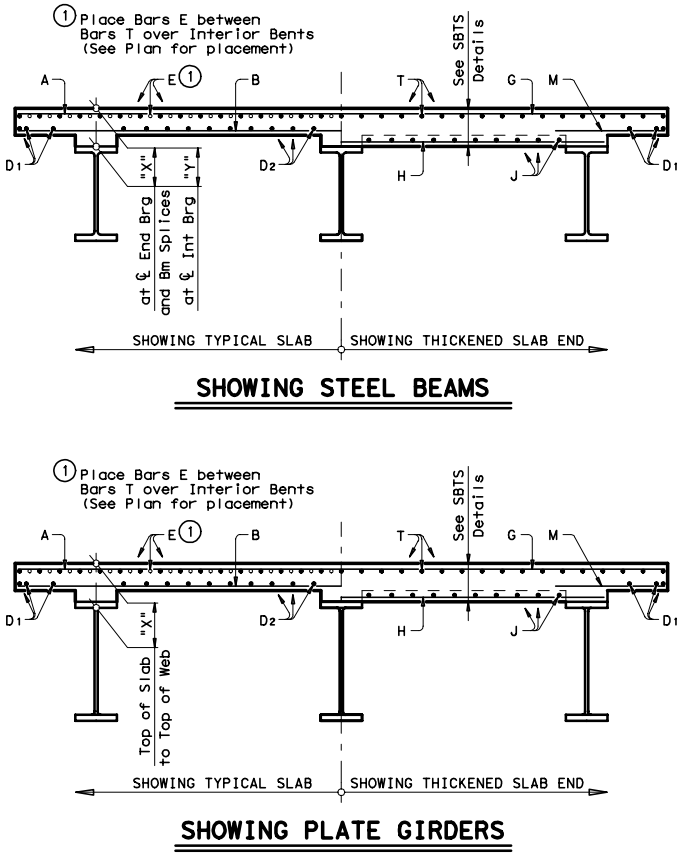


Figure 6-9: Typical Transverse/Radial Sections. Online users can click 6-9 to view this illustration in PDF.

Section 6
Special Notes

Notes Provided as Guides

These notes are provided as guides. The designer needs to verify the adequacy of these notes and make any modifications as required for each individual structure.

For Plate Girder Fabrication Notes, specify regions where additional tension flange splices are not allowed based on the following:

- 0.10S from either side of approximate point(s) of maximum positive moment
- 0.05S from either side of an interior bearing
- Where S = length c-c bearing of span in which the splice is made.

The designing engineer shall be responsible for providing the detailer the approximate point(s) (0.05S accuracy) of maximum positive bending. For unsymmetrical units, it is not unexpected for this point to be different from span to span.

For Optional Bolted Field Splice Notes, the designing engineer shall be responsible for providing the detailer the bolt and hole sizes and any other special requirements that may be needed.

An example for a weathering steel two span continuous beam unit:

Steel Beam Fabrication Notes:

All structural steel, including connection plates and diaphragms, shall conform to the requirements of A709 Grade 50W and shall be paid for at the unit price bid for "Structural Steel-HS".

All structural steel shall remain unpainted.

Beams are classified as tension components and shall conform to Item 442.3(1).

All dimensions shown in Beam Elevation(s) are measured horizontally along beam centerline(s).

Shop beam splices shall be made by full penetration groove welds in accordance with Item 441, "Steel Structures".

Field Splices shall be made by full penetration groove welds or, at the Contractor's option, may be bolted. Structural Steel pay weights shall be based on welded Field Splices.

An example for a weathering steel plate girder unit with more than two spans and the point of maximum positive moment for the end spans is at 0.4S, approximately, and at 0.5S, approximately, for interior span(s):

Plate Girder Fabrication Notes:

All structural steel, including stiffeners and diaphragms, shall conform to the requirements of A709 Grade 50W and shall be paid for at the unit price bid for "Structural Steel-HS".

All structural steel shall remain unpainted.

Girder tension flanges and webs are classified as tension components and shall conform to Item 442.3(1).

All dimensions shown in Girder Elevation(s) are measured horizontally along girder centerline(s).

Except at changes in section, shop or field flange and web splices may be located as desirable to optimize plate lengths and erection procedures, except that splices will not be allowed where a 40' or less unspliced length would suffice. In addition, tension flange splices will not be allowed within 0.05S either side of an interior bearing, within 0.10S either side of the centerline of the interior span, nor within the range between 0.30S and 0.50S from the end bearings (S = length c-c bearing of span in which the splice is made).

Flange and Web splices shall be made by full penetration groove welds in accordance with Item 441, "Steel Structures".

Field Splices shall be made by full penetration groove welds or, at the Contractor's option, may be bolted. Structural Steel pay weights shall be based on welded Field Splices.

An example for a painted steel plate girder unit with two equal length spans and the point of maximum positive moment for the spans is 0.4S, approximately:

Plate Girder Fabrication Notes:

All structural steel, including stiffeners and diaphragms, shall conform to the requirements of A709 Grade 50 or Grade 50W and shall be paid for at the unit price bid for "Structural Steel-HS".

All structural steel shall be painted.

Girder tension flanges and webs are classified as tension components and shall conform to Item 442.3(1).

All dimensions shown in Girder Elevation(s) are measured horizontally along girder centerline(s).

Except at changes in section, shop or field flange and web splices may be located as desirable to optimize plate lengths and erection procedures, except that splices will not be allowed where a 40' or less unspliced length would suffice. In addition, tension flange splices will not be allowed within 0.05S either side of the interior bearing, nor within the range between 0.30S and 0.50S from the end bearings (S = length c-c bearing of span in which the splice is made).

Flange and Web splices shall be made by full penetration groove welds in accordance with Item 441, "Steel Structures".

Field Splices shall be made by full penetration groove welds or, at the Contractor's option, may be bolted. Structural Steel pay weights shall be based on welded Field Splices.

Example notes for optional bolted field splices.

Optional Bolted Field Splice Notes:

All Bolts shall be x" Dia A325 with one hardened washer each and shall be tightened in accordance with Item 447. All holes shall be x" Dia.

All splice plates shall conform to A709 Grade xx.

All splice plates are classified as tension components and shall conform to Item 442.3(1).

Bolts shall be installed with heads on fascia side of outside Beam (or Girder) webs. Bottom flange splice bolts shall be installed with heads facing down.

Structural steel pay weight shall be based on welded field splices regardless of splice type chosen.

An example note when allowing continuous slab placement, to be shown in conjunction with Concrete Placement Sequence:

At the Contractor's option, continuous placement may be used. For continuous placement, the minimum rate of concrete placing and finishing shall be not less than 30 linear feet of bridge deck per hour.

Typical note to be shown in conjunction with Web Camber Diagram of plate girder spans:

Webs may be cut on straight lines between ordinates shown or to a smooth curve at the Fabricator's option. Ordinates shown include total dead load deflection and vertical curve corrections.

Section 7
Common Plate and Shape Designations

Examples of Plate and Shape Designation

Cross sectional areas of plates and shapes are shown without inch designation. Lengths are given in feet and inches. Multiple plates or shapes have the quantity preceding the plate or shape designation. If an individual plate is detailed with width and length dimensions, only the thickness needs to be called out separately.

Examples of how to call out plate and commonly encountered shapes:

Table 6-1: Examples of Call Outs

Plate or Shape	Shape Designation
Plate (e.g. flange and web plate)	PL 1 x 24 2 - PL 2 x 30 x 25'-0" PL 1/2
Wide Flange shapes	W 36 x 230
H-Piling	HP 14 x 73 x 40'-0"
Angles	L 4 x 4 x 3/8 x 0'-6" 4 - L 6 x 6 x 1/2 x 5'-6"
Channels	C 12 x 30 x 6'-2 1/2" MC 10 x 28.5
Structural Tees	WT 7 x 26.5 ST 2.5 x 5 x 0'-4"
Structural Tube	TS 16 x 16 x 0.500
Pipe	Pipe 8 XXS x 9'-0"

Section 8
Connection Details

Weld Detailing

Welding symbols shall be detailed as shown in **ANSI** / **AWS** A2.4-93 "Standard Symbols for Welding, Brazing and Nondestructive Examination". More current versions of this publication should be used if they become available.

Dimensions and proportions of weld symbols are given in Appendix A of **AWS** A2.4.

No inch designation is given with weld sizes, effective throats, depth of preparation, etc. Angles are shown with the degree symbol.

Note that there are no curves in welding symbol leader lines.

Bolt Detailing

See **AISC** Manual of Steel Construction for dimensions of bolt heads and nuts.

Hole size (standard, oversize, short slot, and long slot), minimum and maximum spacing, and minimum and maximum edge distances shall be in accordance with the **AASHTO** Standard Specifications for Highway Bridges.

Minimum edge distances should preferably be increased 1/4" over the AASHTO minimums.

Bolt lengths in joints do not typically need to be shown.

For anchor bolts/anchor rods, show minimum projection and minimum embedment. Total length is not necessary.

For high strength bolting (A325 or A490 bolts), washer requirements shall be as set forth in the AASHTO Standard Specifications, except that A325 and A490 bolts shall always have at least one washer (TxDOT requirement).

Note any bolt orientation requirements (e.g., bolts shall be installed with heads on fascia sides of exterior girder/beam web splices and with heads down on bottom flange splices).

Verify entering and tightening clearances as required in **AISC** Manual of Steel Construction.

Section 9
Substructure and Bearings

Bearing Seat Details

The beam spacing shall be measured along the centerline of cap. The centerline of bearing shall be measured along the centerline of beam. The buildup shall follow the skew of the beam. Buildup dimensions need be shown only once in this view. Typical bearing seat buildup details for bents and abutments with standard elastomeric bearings (as shown on standard SEB) are shown below. Note that unusual conditions may require special details.

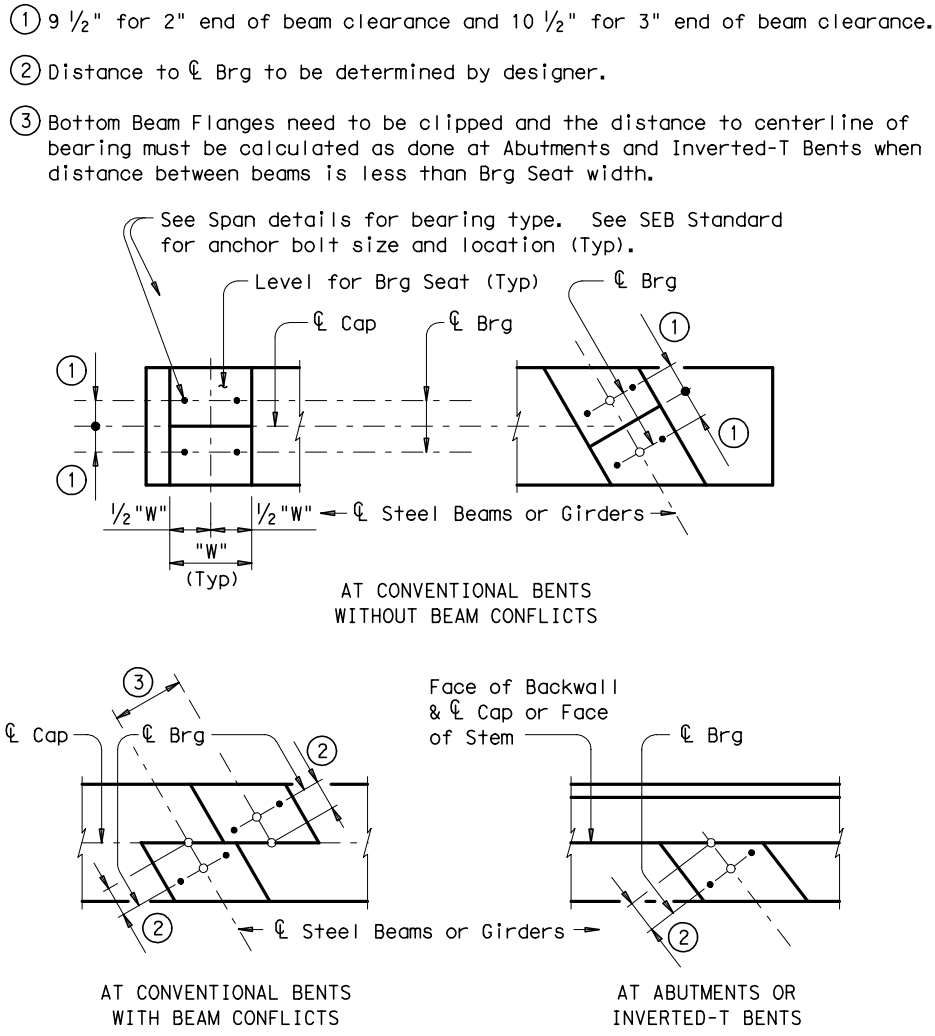


Figure 6-10: Typical Bearing Seat Plan Views for (SE) Bearings. Online users can click 6-10 to view this illustration in PDF.

Brg	"W"
SE 1	2′-0"
SE 2	2′-2"
SE 3	2′-4"
SE 4	2′-6"
SE 5	2′-10"
SE 6	3′-0"
SE 7	3′-4"

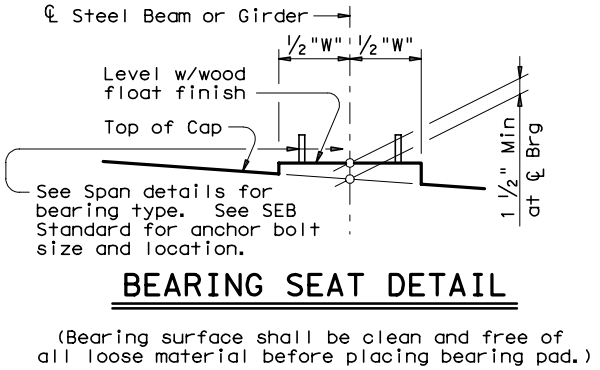


Figure 6-11: Typical (SE) Bearing Seat Detail. Online users can click 6-11 to view this illustration in PDF.

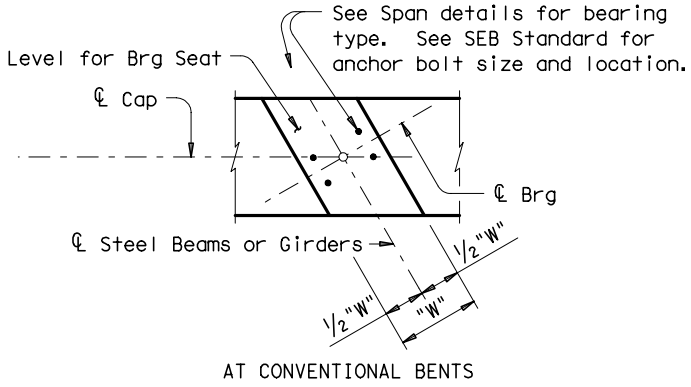


Figure 6-12: Typical Bearing Seat Plan View for (IF) Bearing. Online users can click 6-12 to view this illustration in PDF.

Brg	"W"
IF 1	2′-2"
IF 2	2′-6"
IF 3	2′-6"
IF 4	2′-8"
IF 5	2′-10"
IF 6	3′-2"
IF 7	3′-4"
IF 8	3′-8"

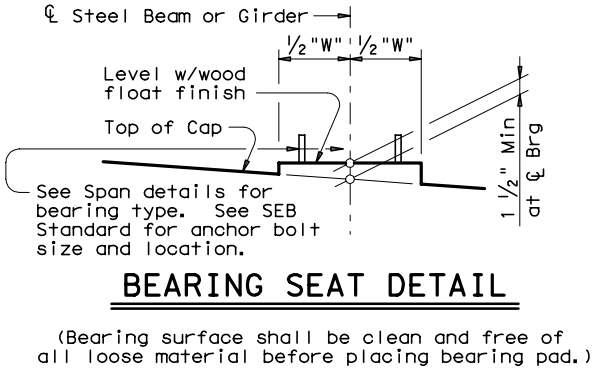


Figure 6-13: Typical (IF) Bearing Seat Detail. Online users can click 6-13 to view this illustration in PDF.

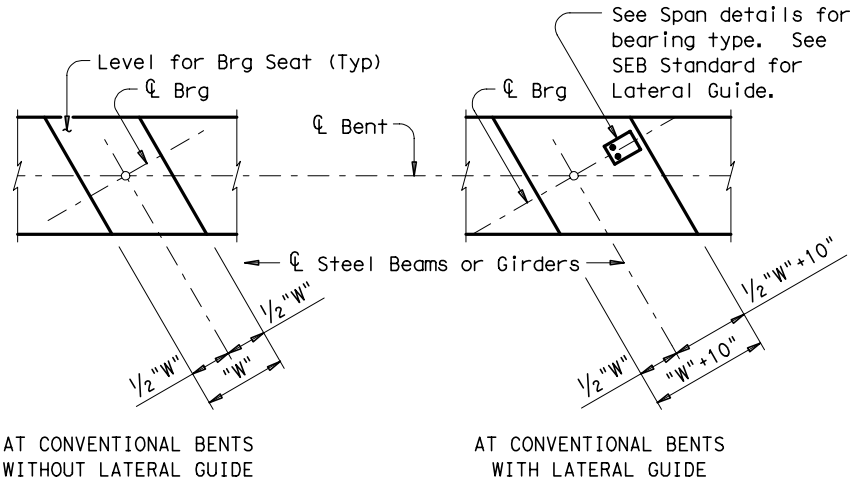
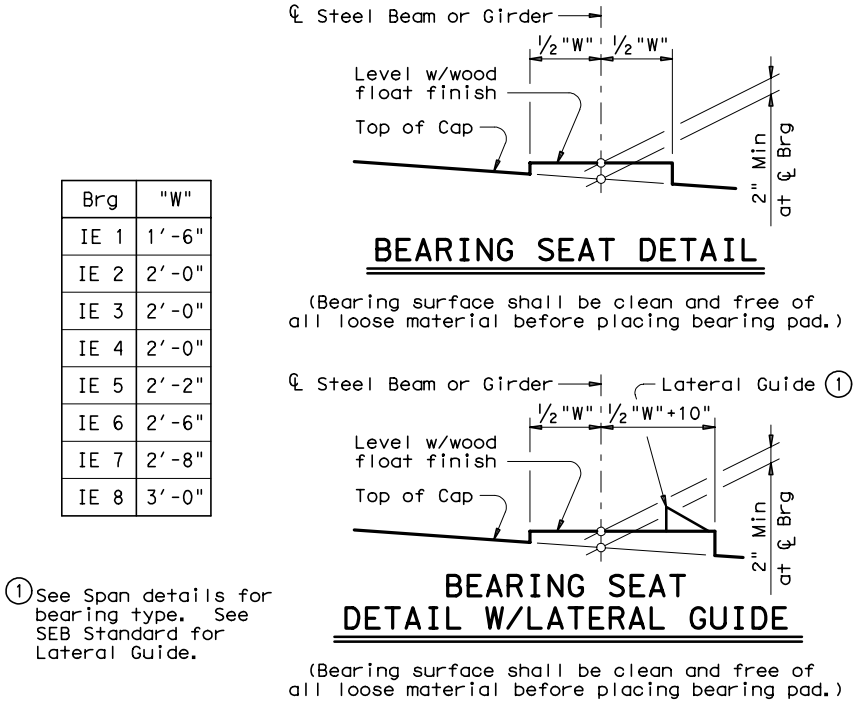


Figure 6-14: Typical Bearing Seat Plan Views for (IE) Bearings. Online users can click 6-14 to view this illustration in PDF.

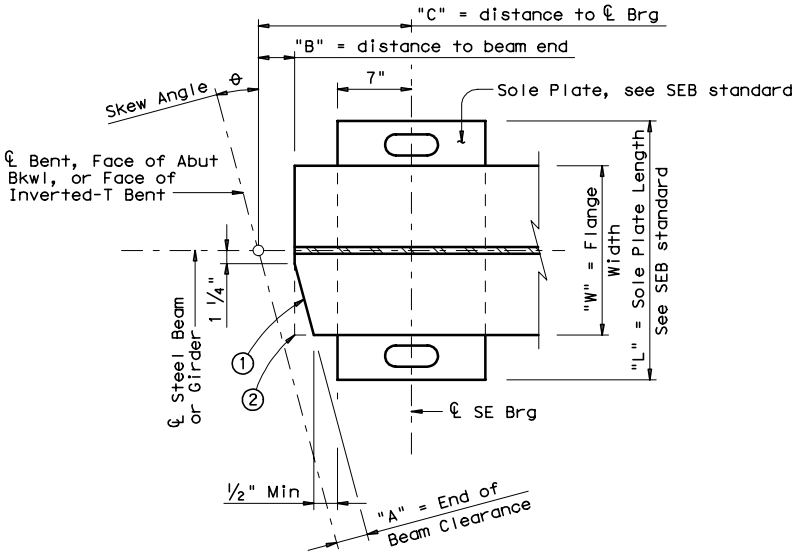


Brg	"W"
IE 1	1′-6"
IE 2	2′-0"
IE 3	2′-0"
IE 4	2′-0"
IE 5	2′-2"
IE 6	2′-6"
IE 7	2′-8"
IE 8	3′-0"

Figure 6-15: Typical (IE) Bearing Seat Details. Online users can click 6-15 to view this illustration in PDF.

Beam End and Centerline of Bearing

To determine the distance to beam ends and centerlines of bearing when using SE type bearings from the standard details sheet SEB, see the formulae below:



① Top and bottom flanges are clipped parallel to face of abutment backwall, faces of Inverted-T bents, or where beam conflicts exist. Top flange is clipped parallel to centerline of joint at conventional bents.

② Bottom flange at conventional bents is not clipped unless conflict exists with beams in adjacent span.

"A" = 2" Min at conventional bents; may be increased to 3" at Abutments and Inverted-T bents.

$$\text{"B"} = \frac{\text{"A"}}{\cos\theta} + 1.25\text{" Tan } \theta\text{, rounded up to nearest } 1/4\text{"}.$$

"C"(for un-clipped bottom flange) = "B" + 7.5", rounded up to nearest ½"

$$\text{"C"(for clipped bottom flange)} = \frac{\text{"A"}}{\cos\theta} + \frac{\text{"W"}}{2} \text{ Tan } \theta + 7.5\text{"}$$

$$\text{or} = \frac{\text{"A"}}{\cos\theta} + \frac{\text{"L"}}{2} \text{ Tan } \theta + 7\text{", whichever is greater, rounded up to nearest } 1/2\text{"}.$$

Example:
Abutment, SE 5 Brg, 24" flange width,
Skew Angle = 45°
"L" = 33"
"A" = 3"

$$\text{"B"} = \frac{3\text{"}}{\cos 45^\circ} + 1.25\text{" Tan } 45^\circ = 5.49\text{", use } 5.5\text{"}$$

$$\text{"C"} = \frac{3\text{"}}{\cos 45^\circ} + \frac{24\text{"}}{2} \text{ Tan } 45^\circ + 7.5\text{"} = 23.74\text{"}$$

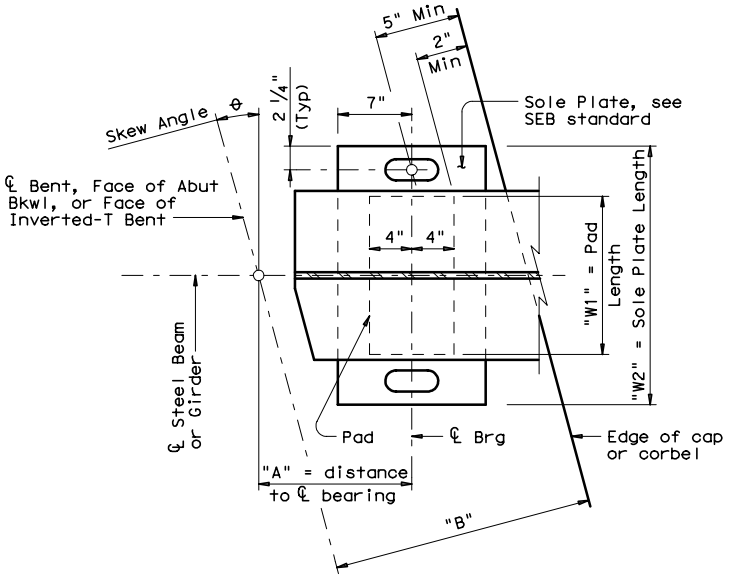
$$\text{"C"} = \frac{3\text{"}}{\cos 45^\circ} + \frac{33\text{"}}{2} \text{ Tan } 45^\circ + 7\text{"} = 27.74\text{", } 27.74\text{" controls, use } 28\text{"}$$

Figure 6-16: Beam End and Centerline of Bearing Calculations. Online users can click 6-16 to view this illustration in PDF.

Substructure Width

To determine the required substructure width to accommodate the bearings shown on the standard details sheet SEB, see the formulae below:

For end bearings (SE) on skewed abutments, the required width of the abutment can be excessive if placing the face of backwall at abutment centerline. In these cases, the designer should determine if it is best to place the back of backwall at the back of the cap. If this is done, adjustments must be made to standard abutment detailing and the location of the foundation centerline must be clearly shown on the layout and abutment details.



$$"B" = 2" + \frac{"W1"}{2} \text{ Sin } \theta + ("A" + 4") \text{ Cos } \theta \text{ , or}$$

$$"B" = 5" + \left(\frac{"W2"}{2} - 2.25"\right) \text{ Sin } \theta + "A" \text{ Cos } \theta, \text{ whichever is greater}$$

If Skew Angle = 0°, "B" = 6" + "A" as absolute minimum.

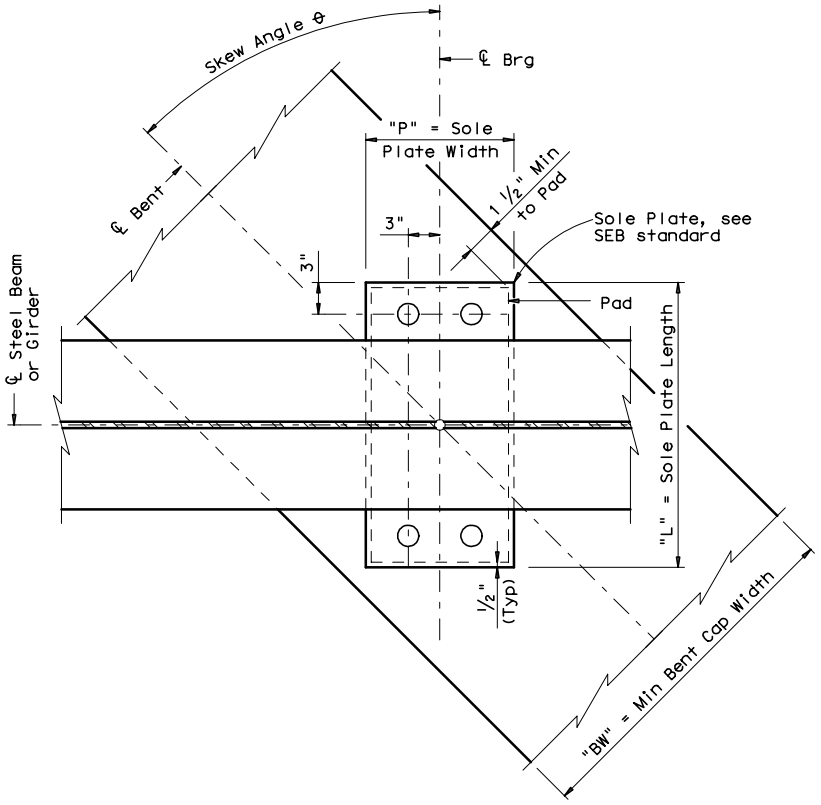
Example:
Determine minimum beam ledge width at Abutment.
Skew Angle = 45°
"A" = 2'-4" (28")
SE 5 Brg

"W1" = 23"
"W2" = 33" } from SEB standard

$$"B" = 2" + \frac{23"}{2} \text{ Sin } 45° + (28" + 4") \text{ Cos } 45° = 32.76"$$

$$"B" = 5" + \left(\frac{33"}{2} - 2.25"\right) \text{ Sin } 45° + 28" \text{ Cos } 45° = 34.88", \text{ Use } 35" \text{ minimum}$$

Figure 6-17: Minimum Beam Ledge Width Calculation for (SE) Bearings. Online users can click 6-17 to view this illustration in PDF.



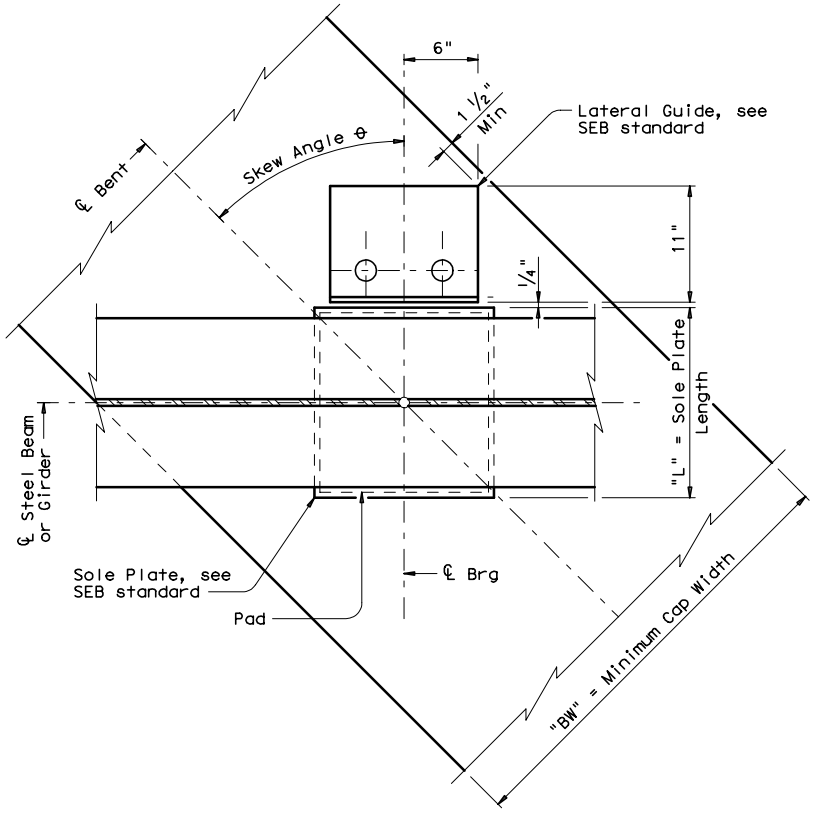
$$\text{"BW"} = 2\left[1.5" + \left(\frac{\text{"L"}}{2} - 0.5"\right)\sin\theta + \left(\frac{\text{"P"}}{2} - 0.5"\right)\cos\theta\right]$$

Example:
Skew Angle = 40°
IF 6 Brg
"L" = 35"
"P" = 18"

$$\text{"BW"} = 2\left[1.5" + \left(\frac{35"}{2} - 0.5"\right)\sin 40° + \left(\frac{18"}{2} - 0.5"\right)\cos 40°\right] = 37.88"$$

Use 38" for minimum cap width.

Figure 6-18: Minimum Bent Cap Width Calculation for (IF) Bearings. Online users can click 6-18 to view this illustration in PDF.



$$\text{"BW"} = 2\left[\left(\frac{\text{"L"}}{2} + 11.25\text{"}\right)\sin\theta + 6\text{"}\cos\theta + 1.5\text{"}\right]$$

Example:
Skew Angle = 35°
IE 6 Brg
"L" = 26"

$$\text{"BW"} = 2\left[\left(\frac{26\text{"}}{2} + 11.25\text{"}\right)\sin 35° + 6\text{"}\cos 35° + 1.5\text{"}\right] = 40.65\text{"}$$

Use 42" for minimum cap width.

Figure 6-19: Minimum Bent Cap Width Calculation for (IE) Bearings. Online users can click 6-19 to view this illustration in PDF.

Section 10
Miscellaneous Details

Drip Tab Detail

Drip tabs are used on unpainted weathering steel beams and girders. Their function is to reduce or eliminate objectionable staining of the concrete substructure. They should be attached to each steel beam or girder since staining may occur prior to slab placement.

Drip tabs should be located on the framing plan. Typically they are to be placed at least 2' away from the face of the substructure, rounded to the nearest 0.5'. Drip tabs are only located on the up-grade side of the substructure.

A sample drip tab detail is provided below.

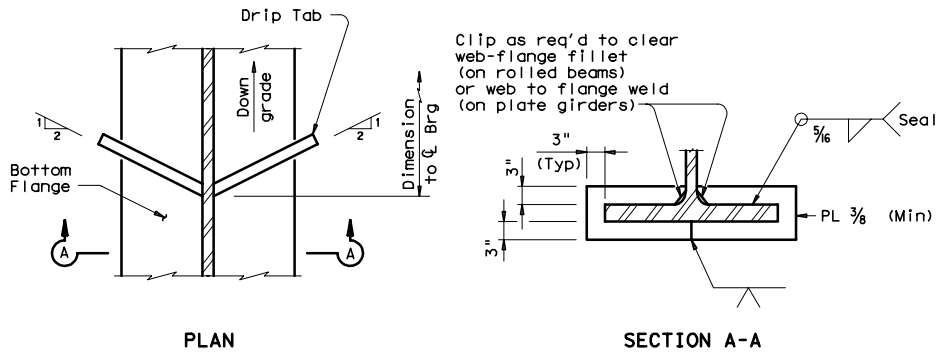


Figure 6-20: Drip Tab Detail. Online users can click 6-20 to view this illustration in PDF.

Dapped Girder End

Dapped girder ends (not for steel beams) are sometimes provided when it is desired that the plate girder section depths closely match that of an adjacent span to prevent large reinforced pedestals. They are also provided at bridge ends to maintain a reasonable backwall height.

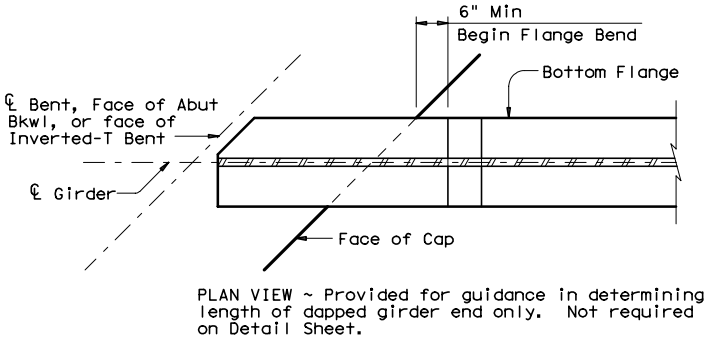


Figure 6-21: Example Showing Dapped End Limits. Online users can click 6-21 to view this illustration in PDF.

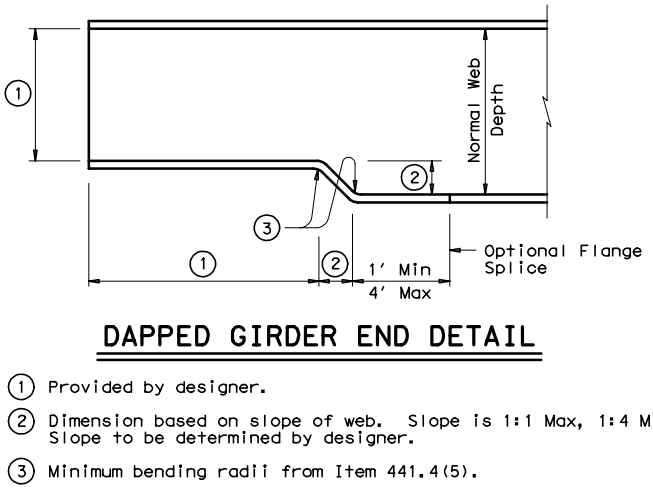


Figure 6-22: Dapped Girder End Detail. Online users can click 6-22 to view this illustration in PDF.

Slab Haunch Reinforcing

In regions of beams where there are no shear connectors and the slab haunch exceeds 3", the haunch shall be reinforced with Bars U. See Chapter 5, Section 8 for Bar U details. These bars shall be spaced at 1'-0" maximum.

Estimated Quantities

To calculate the weight of structural steel, the weight shall be based on 489.54 pounds per cubic foot or 0.2833 pounds per cubic inch. No deductions shall be made for bolt holes. Deductions shall be made for all cuts, capes, and perforations.

See AISC Manual of Steel Construction for weights of bolts, nuts, and washers. Use the appropriate tables for the bolt type.

Accuracy of calculated quantity shall be as given below:

- For 1,000 pounds or less - to the nearest whole pound
- Over 1,000 pounds and less than 100,000 pounds - to the nearest 10 pounds
- Over 100,000 pounds and less than 1,000,000 pounds - to the nearest 100 pounds
- Over 1,000,000 pounds - to the nearest 1,000 pounds

A record of the structural steel weight calculation should be maintained for the duration of the contract.

For slab reinforcing steel weight, the value of 7.0 psf of deck area should be used for most continuous beam or girder units. If the beams or girders are not continuous (simple span construction similar to prestressed concrete beam spans) the value of 6.5 psf should be used. The accuracy of these values should be investigated, especially if sidewalks or raised medians with reinforcing are present.

See Steel Beam and Plate Girder Example Sheets for examples of estimated quantity tables.